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(NASA-CR-117562) WIND TUNNEL TEST DATA OF  
AN .03 SCALE LITTLE JOE 2, APOLLO FORCE  
MODEL (General Dynamics/Convair) 146 p

N79-76093

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6DC-63-025

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**G**GENERAL DYNAMICS CONVAIR

REPORT 1 GDC-63-025

DATE 19 February 1961

12

**TITLE**

## WIND TUNNEL TEST DATA OF AN .03 SCALE

## LITTLE JOE II - APOLLO FORCE MODEL

6-4

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PAGE 1  
REPORT NO. GDC-63-025  
MODEL 12  
DATE 19 February 1963

## TABLE OF CONTENTS

	<u>Page</u>
Symbols . . . . .	ii
Summary . . . . .	1
Introduction . . . . .	1
Discussion . . . . .	1
Run Schedules:	
Table I   7 x 10 Foot Wind Tunnel . . . . .	3
Table II   8 Foot Transonic Tunnel . . . . .	4
Table III   Unitary Plan Wind Tunnel . . . . .	5
List of Figures . . . . .	7

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**G**  
GENERAL DYNAMICS CONVAIR

PAGE 11  
REPORT NO. GDC-63-025  
MODEL 12  
DATE 19 February 1963

~~CONFIDENTIAL~~

S Y M B O L S

$C_A$	Axial - force coefficient,	$C_{A_T} - C_{A_B}$
$C_{A_B}$	Base axial - force coefficient,	$\frac{\text{base axial force}}{qS_B}$
$C_{A_T}$	Total axial coefficient,	$\frac{\text{total axial force}}{qS_B}$
$C_h$	Hinge - moment coefficient,	$\frac{\text{hinge moment}}{qS_f c}$
$C_s$	Rolling - moment coefficient,	$\frac{\text{rolling moment}}{qS_B d}$
$C_M$ (REF.)	Pitching - moment coefficient, about a given reference	$\frac{\text{pitching moment}}{qS_B d}$
$C_N$	Normal - force coefficient,	$\frac{\text{normal force}}{qS_B}$
$C_n$	Yawing - moment coefficient,	$\frac{\text{yawing moment}}{qS_B d}$
$C_Y$	Side - force coefficient,	$\frac{\text{side force}}{qS_B}$
$s_f$	Fin area aft of hinge line	
$d$	Maximum base diameter	
$c$	Mean aerodynamic chord of fin area aft of hinge line	
$q$	Free-stream dynamic pressure ( $1/2 \rho V^2$ ), lb/sq ft.	
$M$	Free-stream Mach number	
$R_N$	Reynolds number per foot	
$S_B$	Base area	
$V$	Free-stream velocity, ft/sec.	

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PAGE 111  
REPORT NO. GDC-63-025  
MODEL 12  
DATE 19 February 1963

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S Y M B O L S (Cont'd)

- $\alpha$  Angle of attack, degrees  
 $\delta$  Control surface deflection, degrees  
 $\rho$  Density of air,  $\frac{\text{slugs}}{\text{ft}^3}$

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WIND TUNNEL TEST DATA OF AN .03 SCALE

LITTLE JOE II - APOLLO FORCE MODEL

SUMMARY

This report presents wind tunnel data for the Little Joe II - Apollo configuration. The tests were conducted by the NASA and tabulated data were furnished to GD/Convair for presentation and analysis. The data in this report are presented without analysis. Analysis of this information will be presented in a subsequent report.

INTRODUCTION

During September, October and November, 1962, tests were conducted of the Little Joe II - Apollo configuration in facilities of the NASA Langley Research Center, Virginia. These facilities included the 7 x 10 foot 300 MPH Wind Tunnel, the 8 foot Transonic Pressure Tunnel, and both legs of the Unitary Plan Tunnel. The objectives of the tests were to investigate the drag, longitudinal stability and control characteristics. The tests covered a range of Mach numbers from 0 to 4.65 and Reynold's numbers from  $0.40 \times 10^6$  to  $4.0 \times 10^6$  per foot. A 0.030 scale model simulating 50 square foot fins and a 160 inch service module was used in all the tunnels.

DISCUSSION

At the time these tests were run, there were two basic configurations under consideration for the escape tower on the Apollo space vehicle. One included a washer-like deflector just forward of the flared skirt of the escape motor (see Figure 1). The second configuration did not include this deflector. These configurations were referred to as washer on and washer off, respectively. Subsequent to the tests it was decided that the escape tower configuration would be with the washer off. The data from the 7 x 10 foot Low Speed Tunnel were all run with the washer on. With this exception, the basic configuration for data comparisons is a complete model with the washer off.

Effects of the escape tower, fins, washer, and reaction control fairings were investigated at various speeds and angles of attack. The tests in the Low Speed Tunnel covered an angle of attack range from -2 to +95 degrees. The tests run in the Transonic and Unitary Plan Tunnels covered angles of attack from approximately -14° to +15°. Control effectiveness in pitch was investigated for control surface deflections from 0° to -30°, and

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roll characteristics for deflections up to 10 degrees. Hinge moment data were recorded for several runs in the Transonic Tunnel. One run was made in the Transonic Tunnel with the model in the secondary pitch plane (see Figure 2). Tables I, II and III present the schedules for the runs made in the various tunnels.

The balance center for the low speed tests was at 9.5 inches from the model base (2.055 diameters), and the pitching and yawing moment data are presented about the base. The first 17 runs of the low speed tests were made using balance UT-19 and the remaining runs (18 through 24) were made using balance UT-12. Comparison of an identical run made with each of the balances shows that the data are not compatible. Information from the NASA shows that the resolution of balance UT-19 is approximately five times that of the balance UT-12. Therefore, data from the first 17 runs should be considered the more accurate.

The balance center for the Transonic and Supersonic tests was at 10.5 inches from the base. The data furnished to Convair by the NASA had the transonic data referenced to the base and the supersonic data referenced to the balance center (2.272 dia.). The transonic pitching moment data was transferred to the reference at the balance center, and is presented about this center. However, the yawing moment data in the transonic region was not transferred to the balance center and is presented about the base. The pitching and yawing moment data for the supersonic tests is all presented about the balance center (2.272 dia.). A summary of the pitching and yawing moment information is presented in the table below.

The data presented herein are referenced to the body axis system. The reference length and area for reducing the six component data was the base diameter (4.620 inches) and the base area (.11642 square feet). The reference length for the hinge moment data was the control surface MAC (.956 inches) and the area (.01350 square feet), respectively.

The axial force data presented in the comparisons have been adjusted to a condition of free stream static pressure at the model base. Base drag data are plotted separately and are included.

#### PITCHING AND YAWING MOMENT PRESENTATION SUMMARY

TEST REGION	M O M E N T R E F E R E N C E	
	PITCHING MOMENT	YAWING MOMENT
Subsonic	9.5 inches from base (2.055 dia.)	9.5 inches from base (2.055 dia.)
Transonic	10.5 inches from base (2.272 dia.)	about the base (0.0 dia.)
Supersonic	10.5 inches from base (2.272 dia.)	10.5 inches from base (2.272 dia.)

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TABLE I  
RUN SCHEDULE  
7 X 10 FOOT 300 MPH WIND TUNNEL

RUN	DYNAMIC PRESSURE	ESCAPE TOWER	REACTION CONTROL FAIRING	HINGE MOMENTS RECORDED	TEST NO. 2				ANGLE OF ATTACK RANGE
					$\delta F_1$	$\delta F_2$	$\delta F_3$	$\delta F_4$	
1	5.75	ON	OFF	NO	OFF	OFF	OFF	OFF	-2° → +95°
2	14.95	ON	ON	NO	0	0	0	0	→
3	5.75	ON	ON	NO	0	0	0	0	→
4	14.95	OFF	ON	NO	0	0	0	0	→
5	5.75	OFF	ON	NO	0	0	0	0	→
6	14.95	ON	ON	NO	0	0	0	0	→
7	5.75	ON	ON	NO	0	0	0	0	→
8	14.95	OFF	ON	NO	0	0	0	0	→
9	5.75	OFF	ON	NO	0	0	0	0	→
10	14.95	ON	ON	NO	0	0	0	0	→
11	5.75	ON	ON	NO	0	0	0	0	→
12	14.95	OFF	ON	NO	0	0	0	0	→
13	5.75	OFF	ON	NO	0	0	0	0	→
14	14.95	ON	ON	NO	0	0	0	0	→
15	5.75	ON	ON	NO	0	0	0	0	→
16	14.95	OFF	ON	NO	0	0	0	0	→
17	5.75	OFF	ON	NO	0	0	0	0	→
18	14.95	ON	ON	NO	0	0	0	0	→
19	5.75	ON	ON	NO	0	0	0	0	→
20	14.95	OFF	ON	NO	0	0	0	0	→
21	5.75	OFF	ON	NO	0	0	0	0	→
22	14.95	ON	ON	NO	0	0	0	0	→
23	5.75	ON	ON	NO	0	0	0	0	→
24	28.60	ON	ON	NO	0	0	0	0	→

TABLE II  
RUN SCHEDULE  
8 FOOT TRANSONIC PRESSURE TUNNEL

RUN	MACH NO. SCHEDULE	ESCAPE TOWER	ESCAPE TOWER WASHER	REACTION CONTROL FAIRING	CONTROL DEFLECTION				KINCH MOMENTS MEASURED	PITCH PLATE	ANGLE OF ATTACK RANGE
					$\delta F_1$	$\delta F_2$	$\delta F_3$	$\delta F_4$			
1	A	ON	OFF ON OFF	ON ON OFF ON	0	0	0	0	OFF	Primary	-11° → +14°
2					0	0	0	0			
3					-10	-10	-10	-10			
4					+10	-10	-10	+10			
5					-20	-20	-20	-20			
6					-30	-30	-30	-30			
7					-5	-5	-5	-5			
8					+5	-5	-5	+5			
9					OFF	OFF	OFF	OFF			
10					ON	0	0	0			
11					ON	0	0	0			
12											

MACH NUMBER SCHEDULE A:  $M = 0.30, 0.50, 0.70, 0.80, 0.90, 0.95, 1.00, 1.20$

TABLE III  
RUN SCHEDULE  
UNITARY PLANE WIND TUNNEL

RUN	MACH NO.	ESCAPE TOWER WASHER	REACTION CONTROL PAIRING	CONTROL DEFLECTION				HINGE MOMENTS RECORDED	PITCH PLANE	ANGLE OF ATTACK RANGE	TEST NO. 406
				$\delta F_1$	$\delta F_2$	$\delta F_3$	$\delta F_4$				
1	1.80	ON	ON	0	0	0	0	NO	Primary	-14° → +15°	Low Leg
2	2.16	ON	OFF	-5	-10	-20	-30	-45			
3	1.57	ON	ON	-5	-10	-20	-30	-45			
4	1.80	ON	ON	-5	-10	-20	-30	-45			
5	2.16	ON	ON	-5	-10	-20	-30	-45			
6	1.57	ON	ON	-5	-10	-20	-30	-45			
7	2.80	ON	ON	-5	-10	-20	-30	-45			
8	1.80	ON	ON	-5	-10	-20	-30	-45			
9	2.16	ON	ON	-5	-10	-20	-30	-45			
10	1.57	ON	ON	-5	-10	-20	-30	-45			
11	2.80	ON	ON	-5	-10	-20	-30	-45			
12	1.80	ON	ON	-5	-10	-20	-30	-45			
13	2.16	ON	ON	-5	-10	-20	-30	-45			
14	1.57	ON	ON	-5	-10	-20	-30	-45			
15	2.80	ON	ON	-5	-10	-20	-30	-45			
16	1.80	ON	ON	-5	-10	-20	-30	-45			
17	2.16	ON	ON	-5	-10	-20	-30	-45			
18	1.57	ON	ON	-5	-10	-20	-30	-45			
19	2.80	ON	ON	-5	-10	-20	-30	-45			
20	1.80	ON	ON	-5	-10	-20	-30	-45			
21	2.16	ON	ON	-5	-10	-20	-30	-45			
22	1.57	ON	ON	-5	-10	-20	-30	-45			
23	2.80	ON	ON	-5	-10	-20	-30	-45			
24	1.80	ON	ON	-5	-10	-20	-30	-45			
25	2.16	ON	ON	-5	-10	-20	-30	-45			
26	1.57	ON	ON	-5	-10	-20	-30	-45			
27	2.80	ON	ON	-5	-10	-20	-30	-45			
28	1.80	ON	ON	-5	-10	-20	-30	-45			
29	2.16	ON	ON	-5	-10	-20	-30	-45			
30	1.57	ON	ON	-5	-10	-20	-30	-45			

TABLE III (Cont'd)

RUN SCHEDULE  
UNITARY PLANE WIND TUNNEL

RUN	MACH NO.	ESCAPE TOWER	ESCAPE TOWER WASHER	REACTION CONTROL FAIRING	CONTROL DEFLECTION				HINGE MOMENTS RECORDED	PITCH PLANE	ANGLE OF ATTACK RANGE	TEST NO. 403
					$\delta F_1$	$\delta F_2$	$\delta F_3$	$\delta F_4$				
29	3.86	ON	OFF	ON	0	0	0	0	NO	PRIMARY	-14° → +15°	
30	4.65				-5	-5	-5	-5				
31	3.86				-5	-5	-5	-5				
32	4.65				-10	-10	-10	-10				
33	3.86				-20	-20	-20	-20				
34	4.65				-20	-20	-20	-20				
35	3.86				-30	-30	-30	-30				
36	4.65				-30	-30	-30	-30				
37	3.86				+5	+5	+5	+5				
38	4.65				+5	+5	+5	+5				
39	3.86				+5	+5	+5	+5				
40	4.65				+5	+5	+5	+5				

High Leg

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L I S T   O F   F I G U R E S

FIGURE	TITLE AND DESCRIPTION	PAGE
1	GENERAL ARRANGEMENT OF LITTLE JOE II APOLLO 0.030 SCALE WIND TUNNEL MODEL	10
2	PRIMARY AND SECONDARY PITCH CONFIGURATIONS	11
3 - 8	CONTROL EFFECTIVENESS ( $C_M$ , $C_N$ , $C_A$ vs $\alpha$ ) $M \approx 0$ $M = 0.30$ $M = 0.50$ $M = 0.70$ $M = 0.80$ $M = 0.90$ $M = 0.95$ $M = 1.00$ $M = 1.20$ $M = 1.57$ $M = 1.80$ $M = 2.16$ $M = 2.80$ $M = 3.86$ $M = 4.65$	12 - 17 18 - 19 20 - 21 22 - 23 24 - 25 26 - 27 28 - 29 30 - 31 32 - 33 34 - 35 36 - 37 38 - 39 40 - 41 42 - 43 44 - 45
37, 37A	ROLL CHARACTERISTICS ( $C_L$ , $C_n$ , $a_Y$ vs $\alpha$ ) $M \approx 0$ $M = 0.30$ $M = 0.50$ $M = 0.70$ $M = 0.80$ $M = 0.90$ $M = 0.95$ $M = 1.00$ $M = 1.20$ $M = 1.57$ $M = 1.80$ $M = 2.16$ $M = 2.80$ $M = 3.86$ $M = 4.65$	46 - 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61

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L I S T   O F   F I G U R E S (Cont'd)

FIGURE	TITLE AND DESCRIPTION	PAGE
52, 53 54, 55 56, 57 58, 59 60, 61 62, 63 64, 65 66, 67 68, 69 70, 71 72, 73	EFFECT OF WASHER ON LONGITUDINAL CHARACTERISTICS ( $C_M$ , $C_N$ , $C_A$ vs $\alpha$ ) $M = 0.30$ $M = 0.50$ $M = 0.70$ $M = 0.80$ $M = 0.90$ $M = 0.95$ $M = 1.00$ $M = 1.20$ $M = 1.57$ $M = 1.80$ $M = 2.16$	62 - 63 64 - 65 66 - 67 68 - 69 70 - 71 72 - 73 74 - 75 76 - 77 78 - 79 80 - 81 82 - 83
74, 75	EFFECT OF ESCAPE TOWER AND FINS ON LONGITUDINAL CHARACTERISTICS ( $C_M$ , $C_N$ , $C_A$ vs $\alpha$ ) $M \geq 0$	84 - 85
76, 77 78, 79 80, 81 82, 83 84, 85 86, 87 88, 89 90, 91	EFFECT OF REACTION CONTROL FAIRINGS AND FINS ON LONGITUDINAL CHARACTERISTICS ( $C_M$ , $C_N$ , $C_A$ vs $\alpha$ ) $M = 0.30$ $M = 0.50$ $M = 0.70$ $M = 0.80$ $M = 0.90$ $M = 0.95$ $M = 1.00$ $M = 1.20$	86 - 87 88 - 89 90 - 91 92 - 93 94 - 95 96 - 97 98 - 99 100 - 101
92 93 94 95 96 97 98 99	HINGE MOMENT CHARACTERISTICS $M = 0.30$ $M = 0.50$ $M = 0.70$ $M = 0.80$ $M = 0.90$ $M = 0.95$ $M = 1.00$ $M = 1.20$	102 103 104 105 106 107 108 109

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PAGE 9  
REPORT NO. GDC-63-025  
MODEL 12  
DATE 19 February 1963

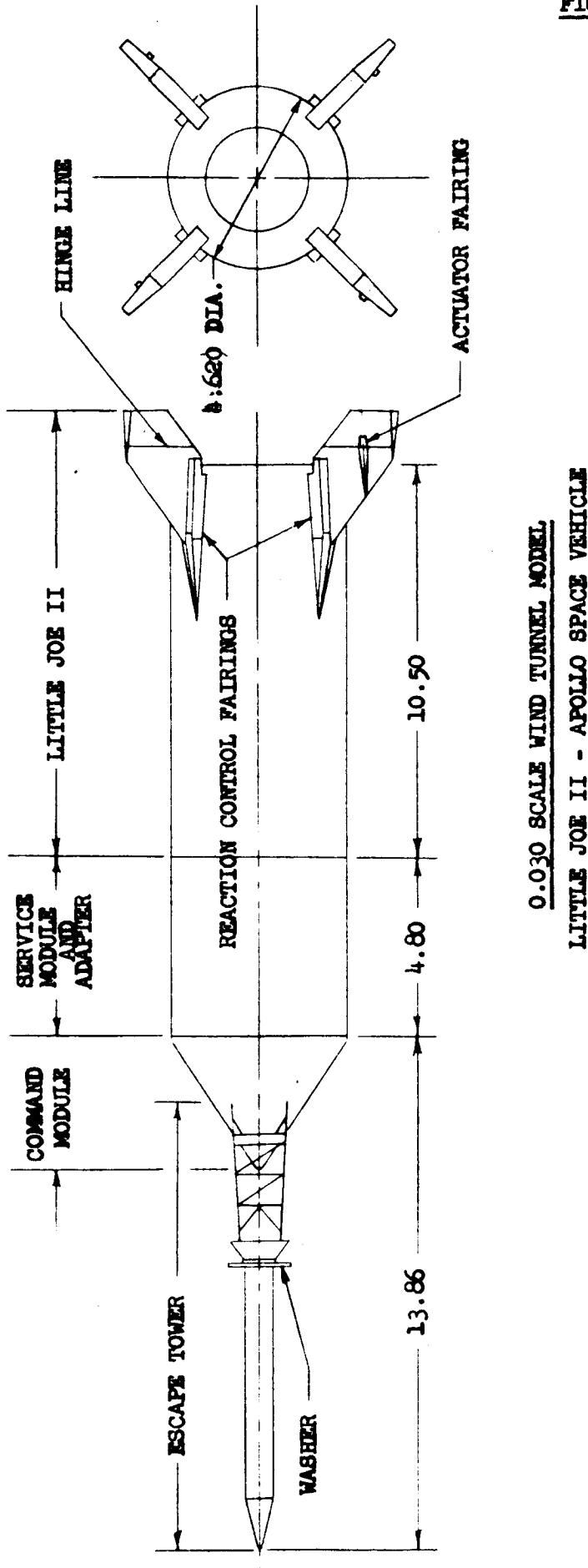
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L I S T   O F   F I G U R E S (Cont'd)

FIGURE	TITLE AND DESCRIPTION	PAGE
100, 101	EFFECT OF DYNAMIC PRESSURE ON LONGITUDINAL CHARACTERISTICS ( $C_M$ , $C_N$ , $C_A$ vs $\alpha$ ) $M \geq 0$	110 - 111
102, 103	COMPARISON OF PRIMARY CONFIGURATION WITH SECONDARY CONFIGURATION ( $C_M$ , $C_N$ , $C_A$ vs $\alpha$ ) $M = 0.30$	112 - 113
104, 105	$M = 0.50$	114 - 115
106, 107	$M = 0.70$	116 - 117
108, 109	$M = 0.80$	118 - 119
110, 111	$M = 0.90$	120 - 121
112, 113	$M = 0.95$	122 - 123
114, 115	$M = 1.00$	124 - 125
116, 117	$M = 1.20$	126 - 127
118	BASE DRAG CHARACTERISTICS $M = 0.30$	128
119	$M = 0.50$	129
120	$M = 0.70$	130
121	$M = 0.80$	131
122	$M = 0.90$	132
123	$M = 0.95$	133
124	$M = 1.00$	134
125	$M = 1.20$	135
126	$M = 1.57$	136
127	$M = 1.80$	137
128	$M = 2.16$	138
129	$M = 2.80$	139
130	$M = 3.86$	140
131	$M = 4.65$	141

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FIGURE 1

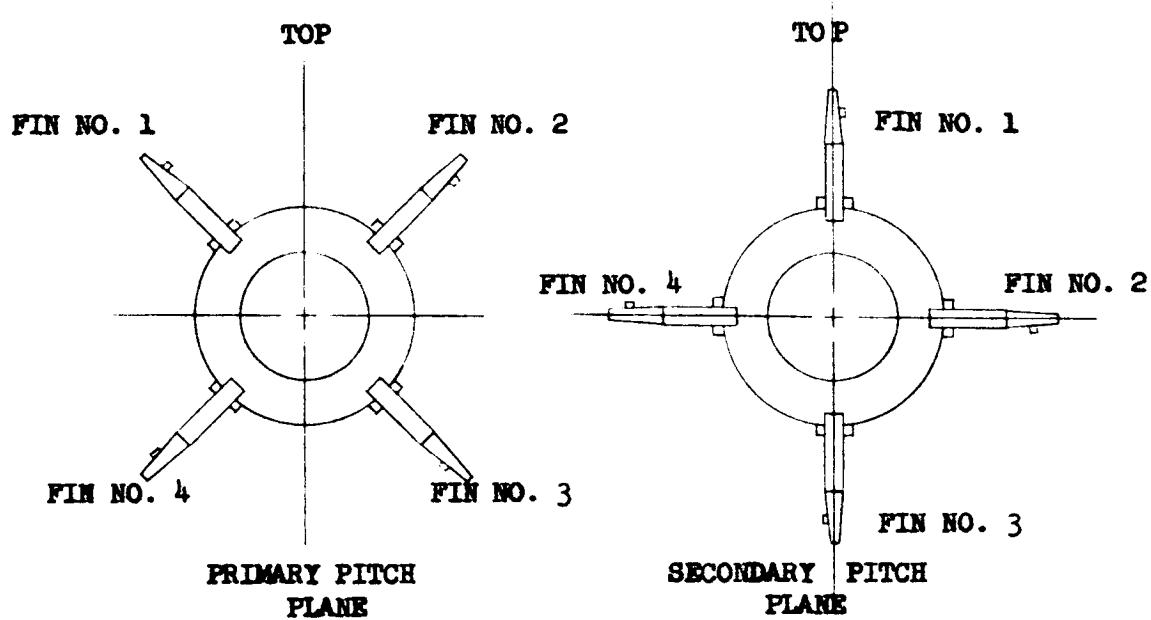


Positive Values for Parameters	
$C_x$	Nose Up
$C_y$	Force Up
$C_M$	Nose Up
$C_A$	Force Aft
$C_x^A$	Force to Right
$C_y^A$	Nose Right
$C_d^A$	Clockwise Rotation
$C_x^d$	Trailing Edge Up
$C_y^d$	Trailing Edge Down
$\delta_{FIN}$	

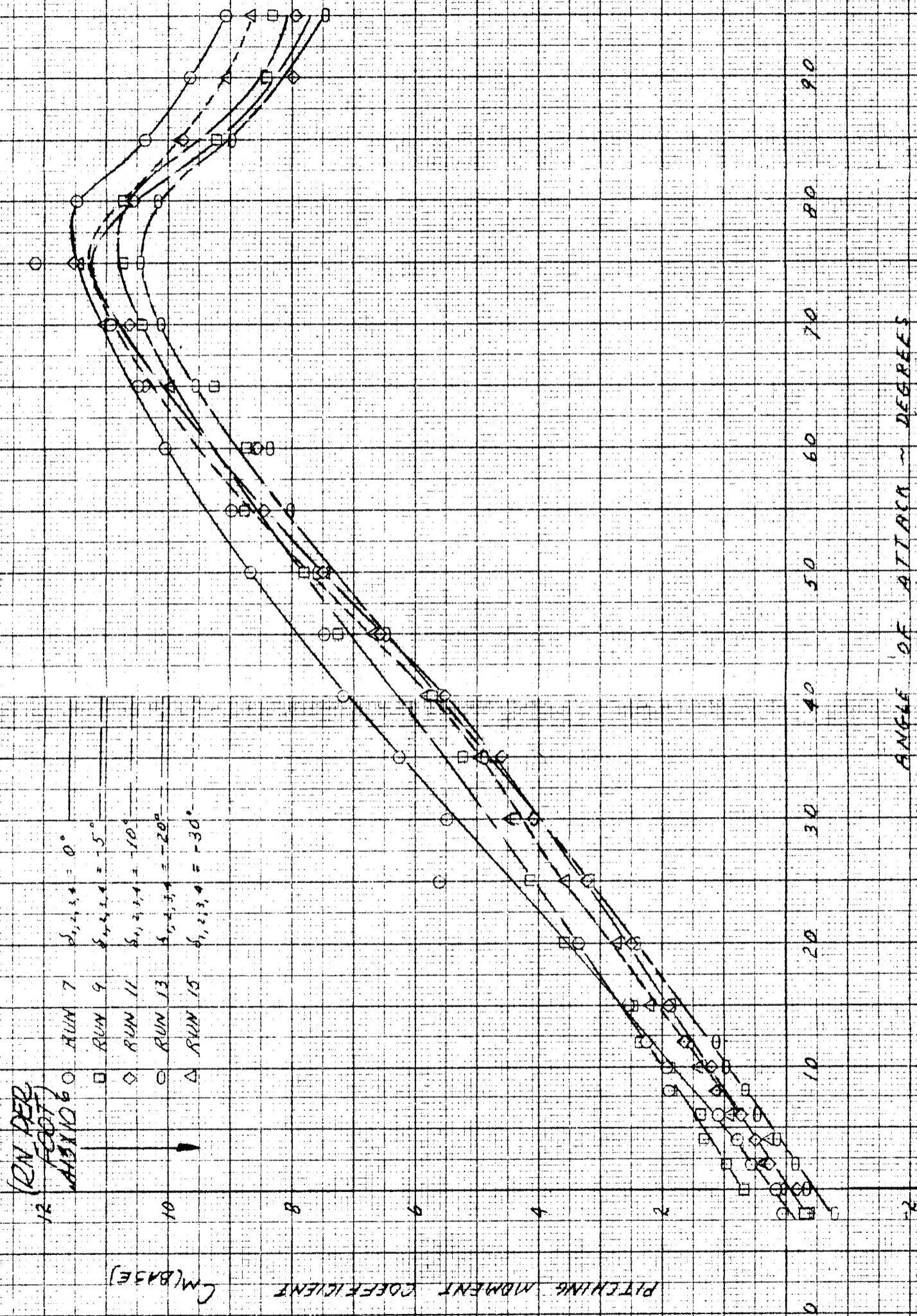
Model 12  
Date 19 February 1963

Page 11  
Report No. GDC-63-025

FIGURE 2



VIEW FROM AFT LOOKING FORWARD



Serial 112 Date 19 January 1963

CONF 222E JOE  
CONF 222E EFFECTIVENESS  
CANOPY TUNNEL ON JOE'S TUNNEL  
WASHED ON 2-5-75 MACH 1.0 ± .0025

FIGURE 4

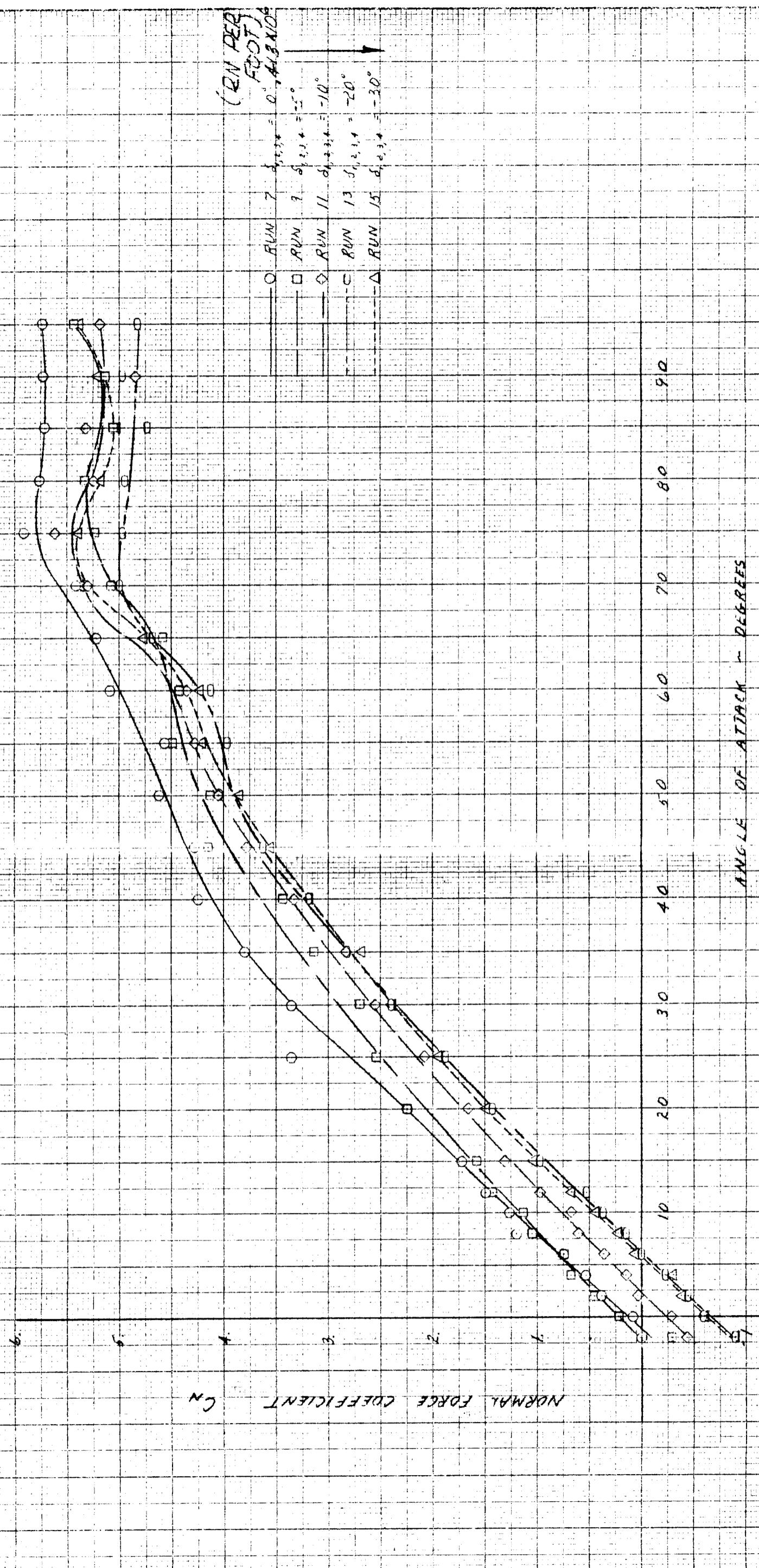




FIGURE 2

LITTLE JOE II  
CONTINUATION OF  
CONTRACT THROTTLE ON SPEED TUNNEL

TESTED ON  $\gamma = 5.75$  MACH NO.: 0.625

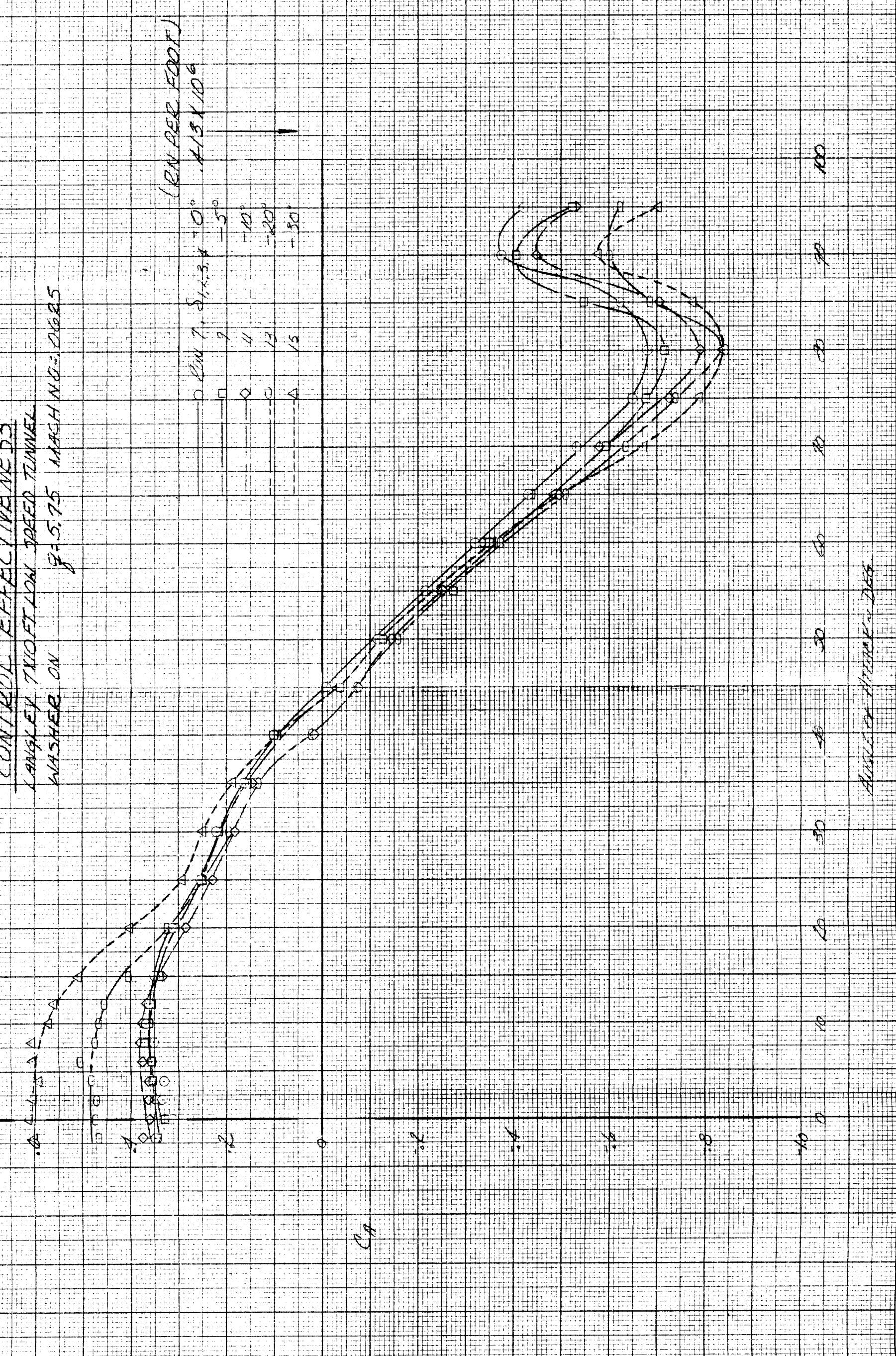
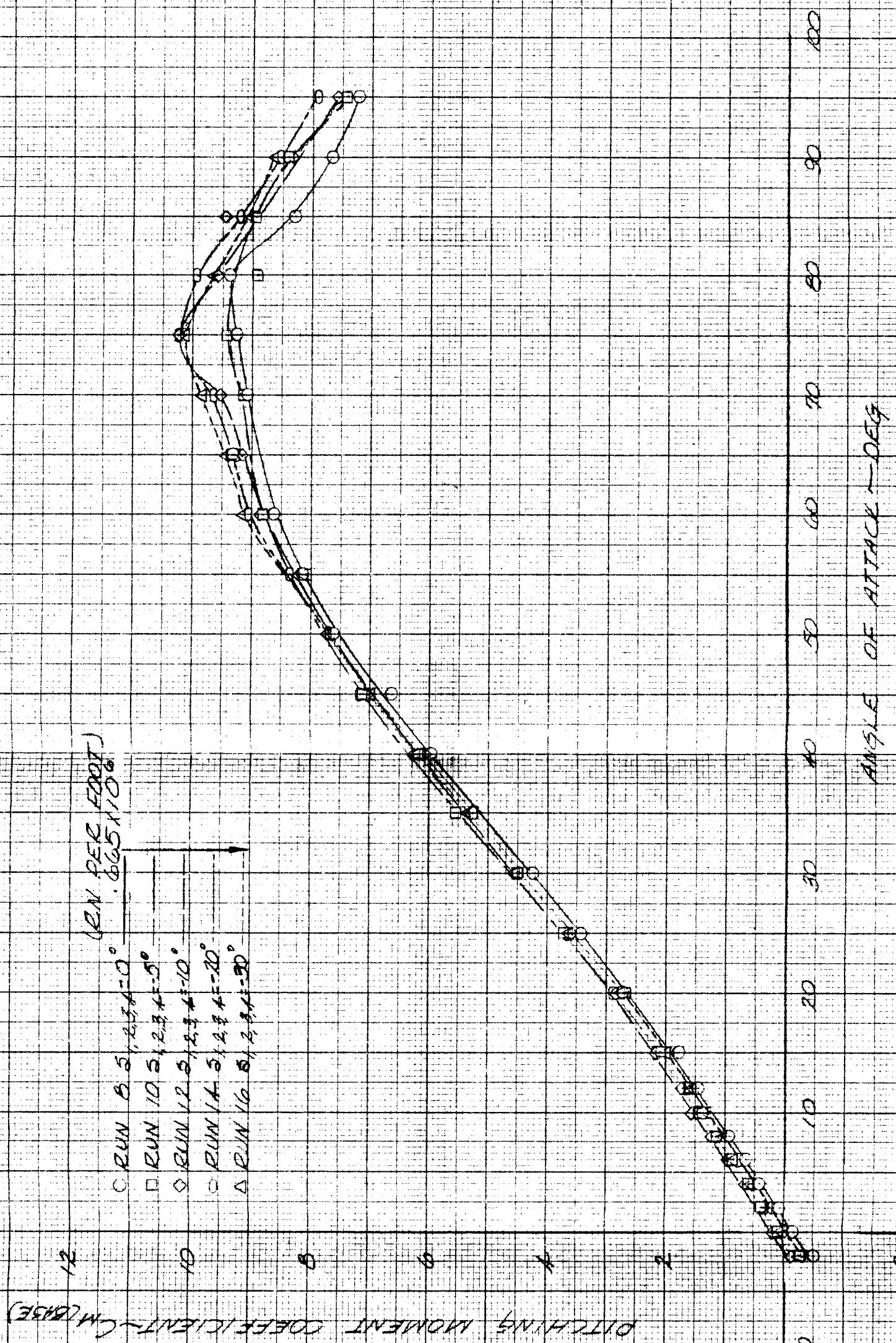


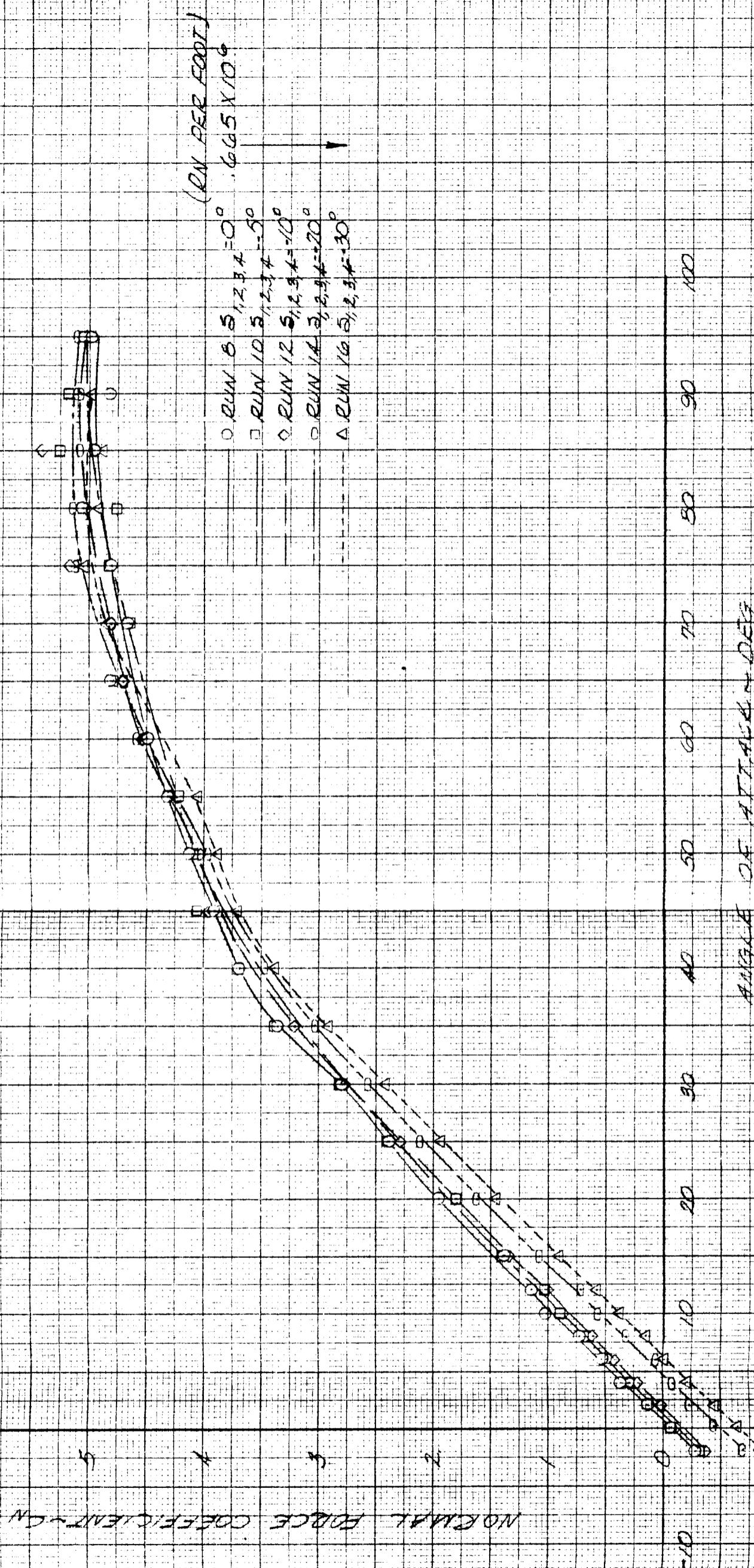
FIGURE 6

CONTINUATION OF EFFECTIVENESS  
MANEUVER TRAIL CON SOED TUNNEL  
WASHED ON  $\beta = 14.95$  DEG NO. 101



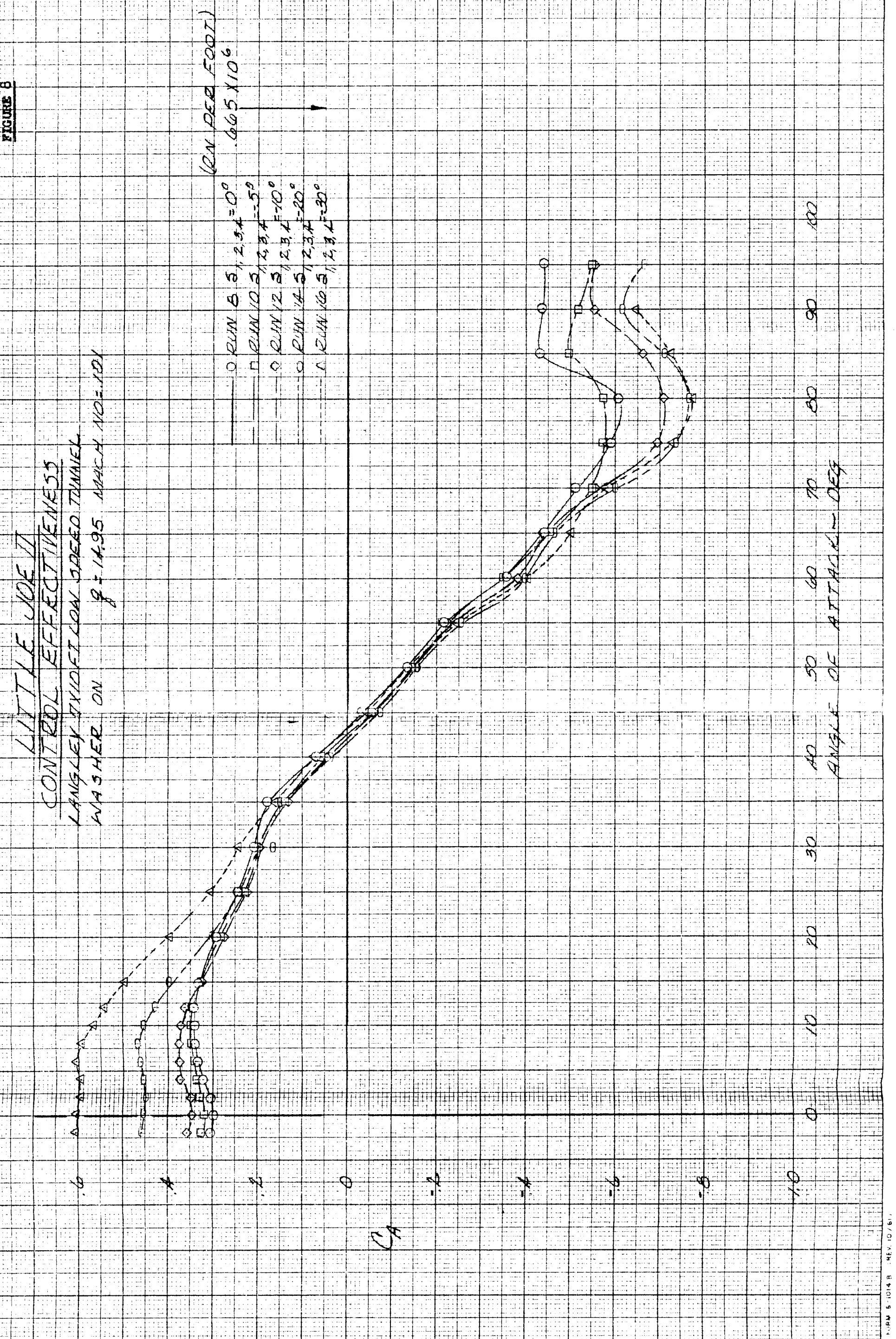
LITTLE 105 1  
CONTINUOUS EFFECTIVE 35  
LANGLEY PILOT LOW SPEED TUNNEL  
WATERSON  
9-14-95 Model No.: 101

FIGURE 7

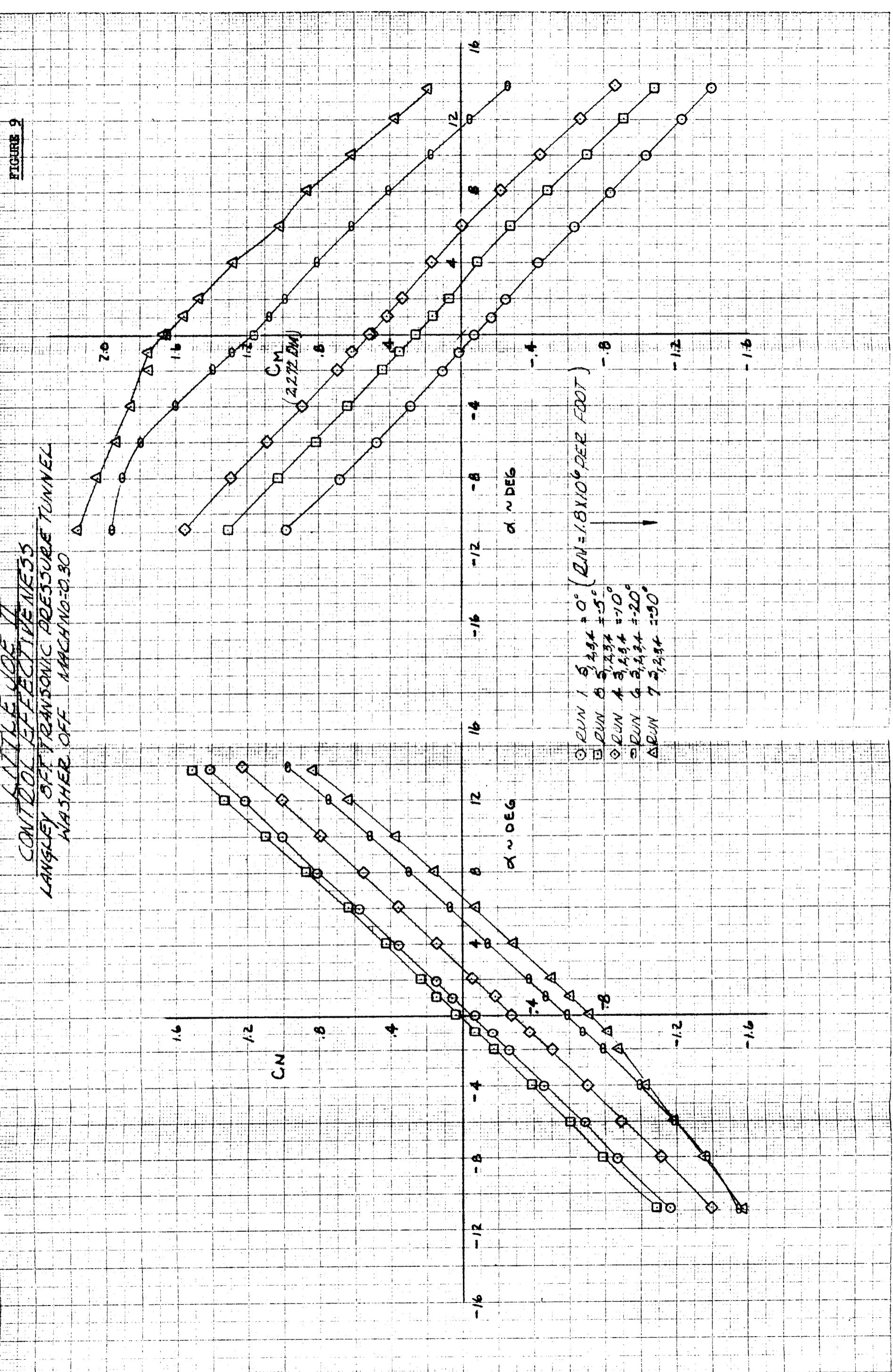


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LITTLE JOE II  
CONTROL EFFECTIVENESS  
ANGLE THROTTLED TUNNEL  
WASHER ON  $\theta = 16.95^\circ$   $A = 10^\circ = 101^\circ$



~~CONT'D OF TEST SHEET 55  
LANGLEY OFF TRANSonic PRESSURE TUNNEL  
WASHER OFF MACH NO-0.30~~



Model 12

19 February 1963

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**CONTROL EFFECTIVENESS**  
 WINGLEY OFF TRANSonic PRESSURE TUNNEL  
 WASHER OFF                    MACH NO=0.30

- RUN 1 5 1,2,3,4 = 0° (DN=1.0X10<sup>6</sup> PER FOOT)
- RUN 5 5 1,2,3,4 = -5°
- ◊ RUN 4 5 1,2,3,4 = +10°
- RUN 6 5 1,2,3,4 = +20°
- △ RUN 7 5 1,2,3,4 = -30°

C<sub>A</sub>

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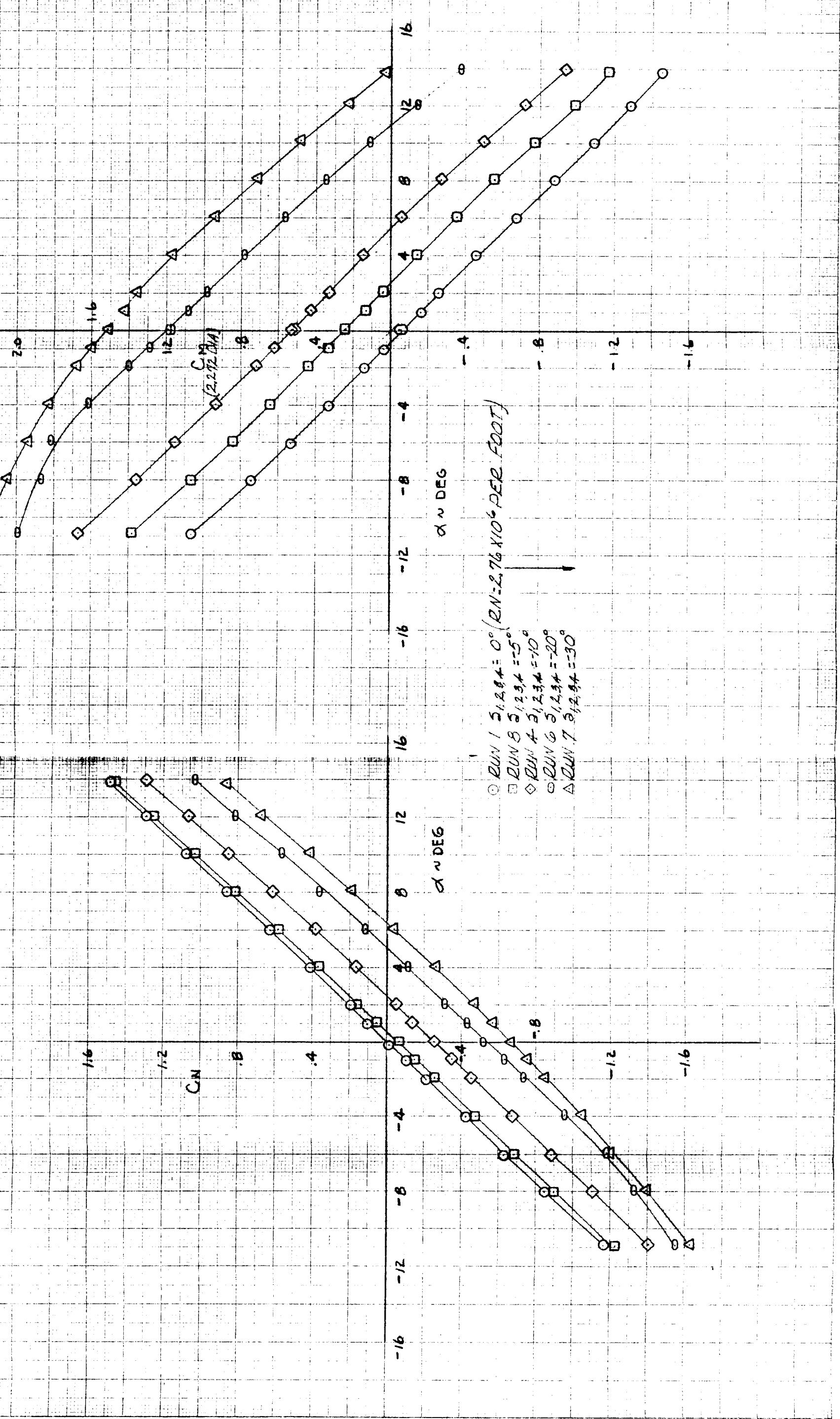
2

1

-16      -12      -8      -4      0      4      8      12      16  
 ANGLE OF ATTACK - DEG

FIGURE 11.

CONT 201 TEST VENUE 35  
LANGLEY 847 PANJANIC PRESSURE TUNNEL  
WASHER OFF MARCH AND = 0.50

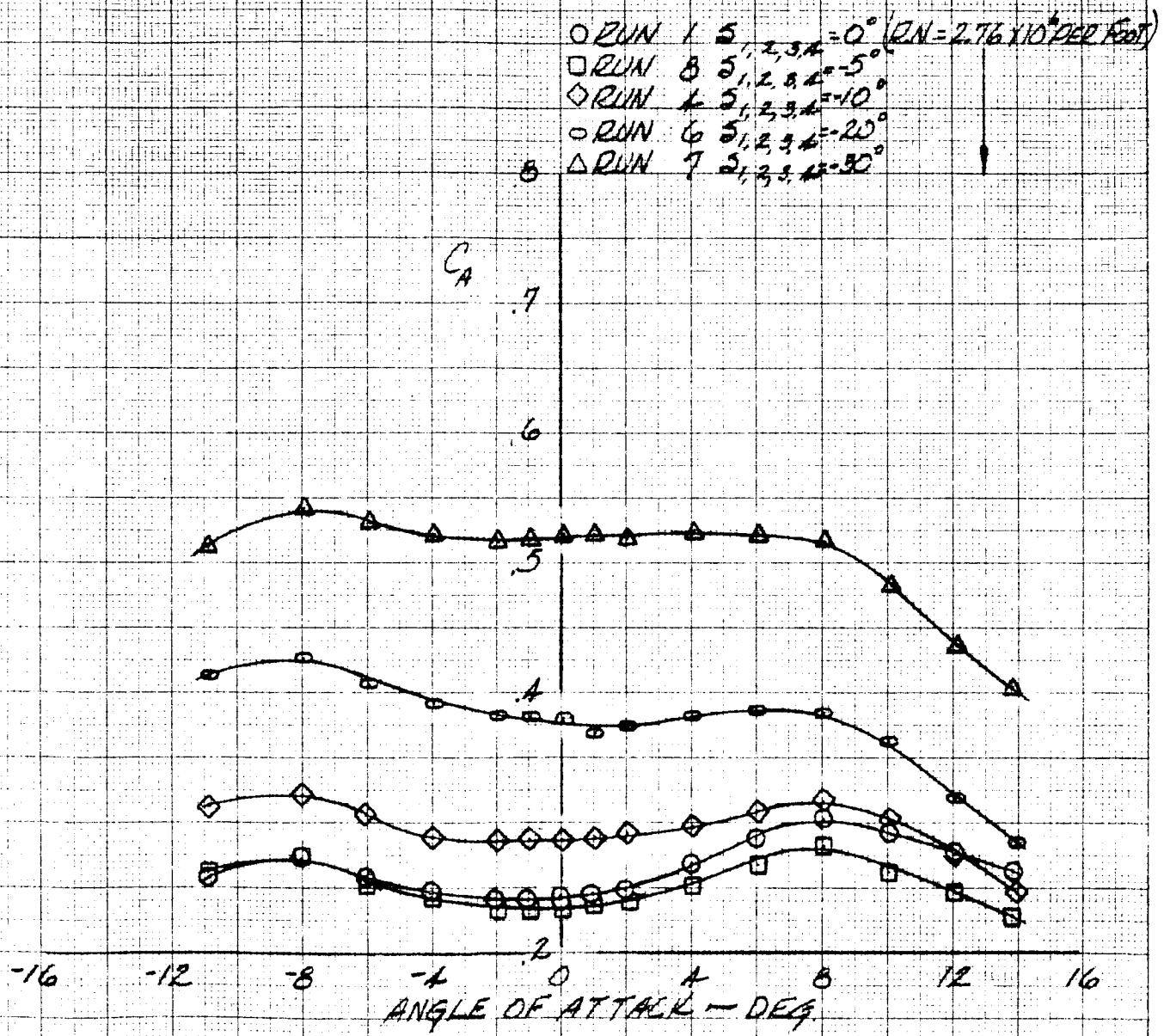


Model 12  
19 February 1963

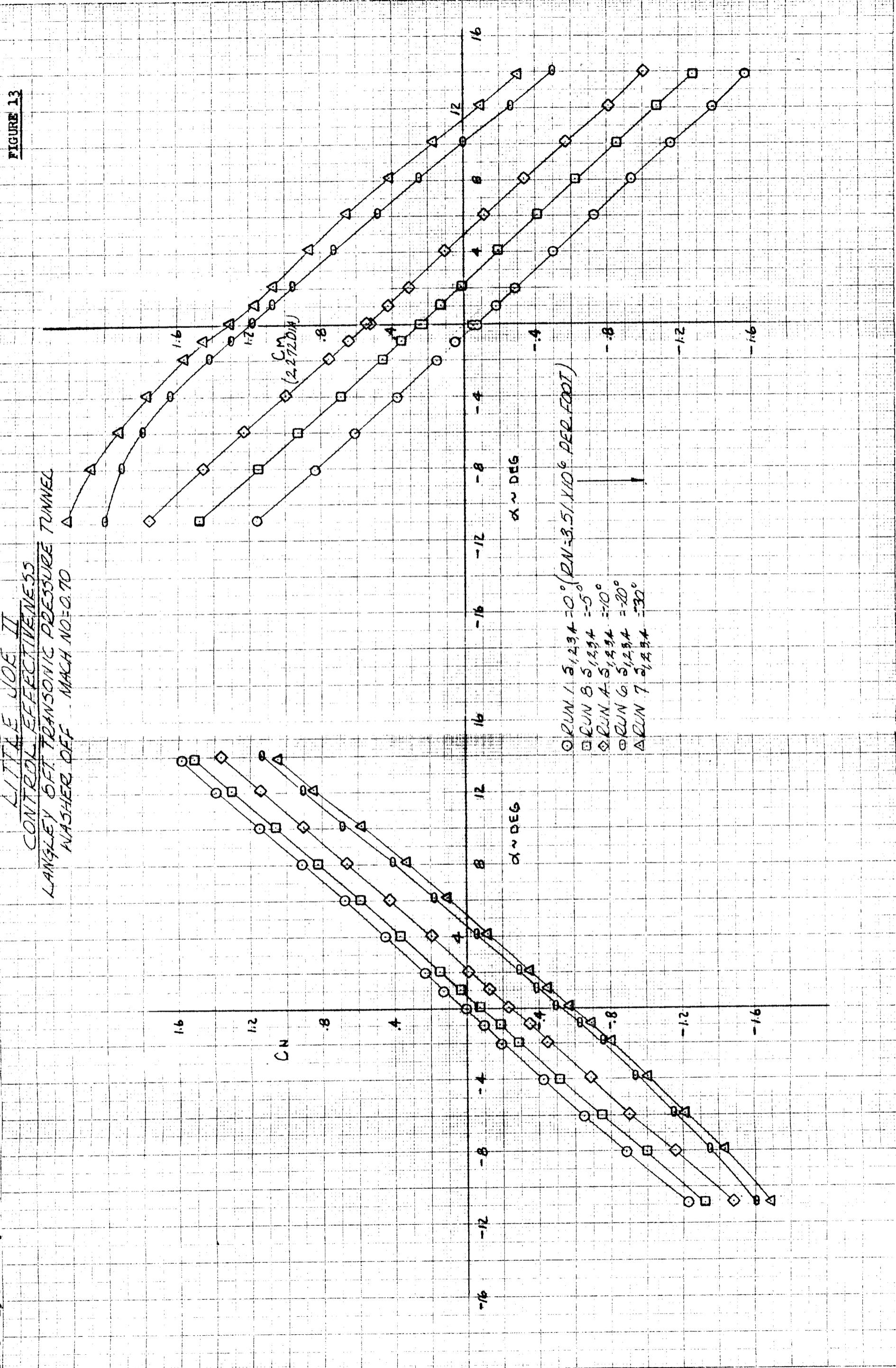
LITTLE JOE II

Page 21  
Report No. GRC-63-425  
Figure 12

CONTROL EFFECTIVENESS  
LANGLEY 8 FT TRANSONIC PRESSURE TUNNEL  
WASHER OFF MACH NO = 0.50



LITTLER JOE II  
CONTROLLING EFFECTIVENESS  
LANGLEY 6 FT TRANSONIC PRESSURE TUNNEL  
WASHER DEF MACH NO=0.70



Model 12  
19 February 1963

LITTLE JOE II

Page 23  
Report No. 63-025  
Figure 14

CONTROL EFFECTIVENESS  
LANGLEY OFF TRANSONIC PRESSURE TUNNEL  
WASHER OFF  
MACH NO = 0.70

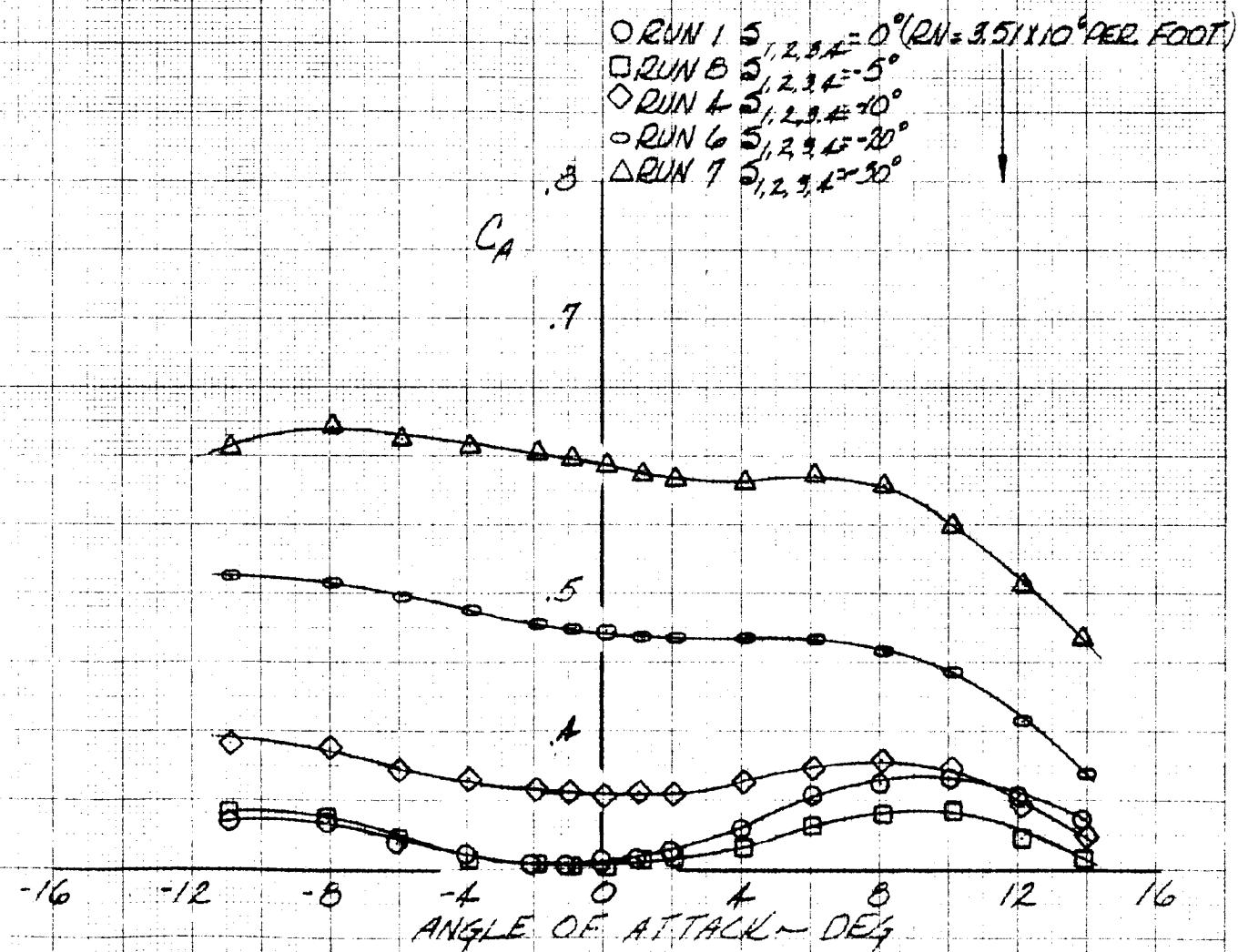
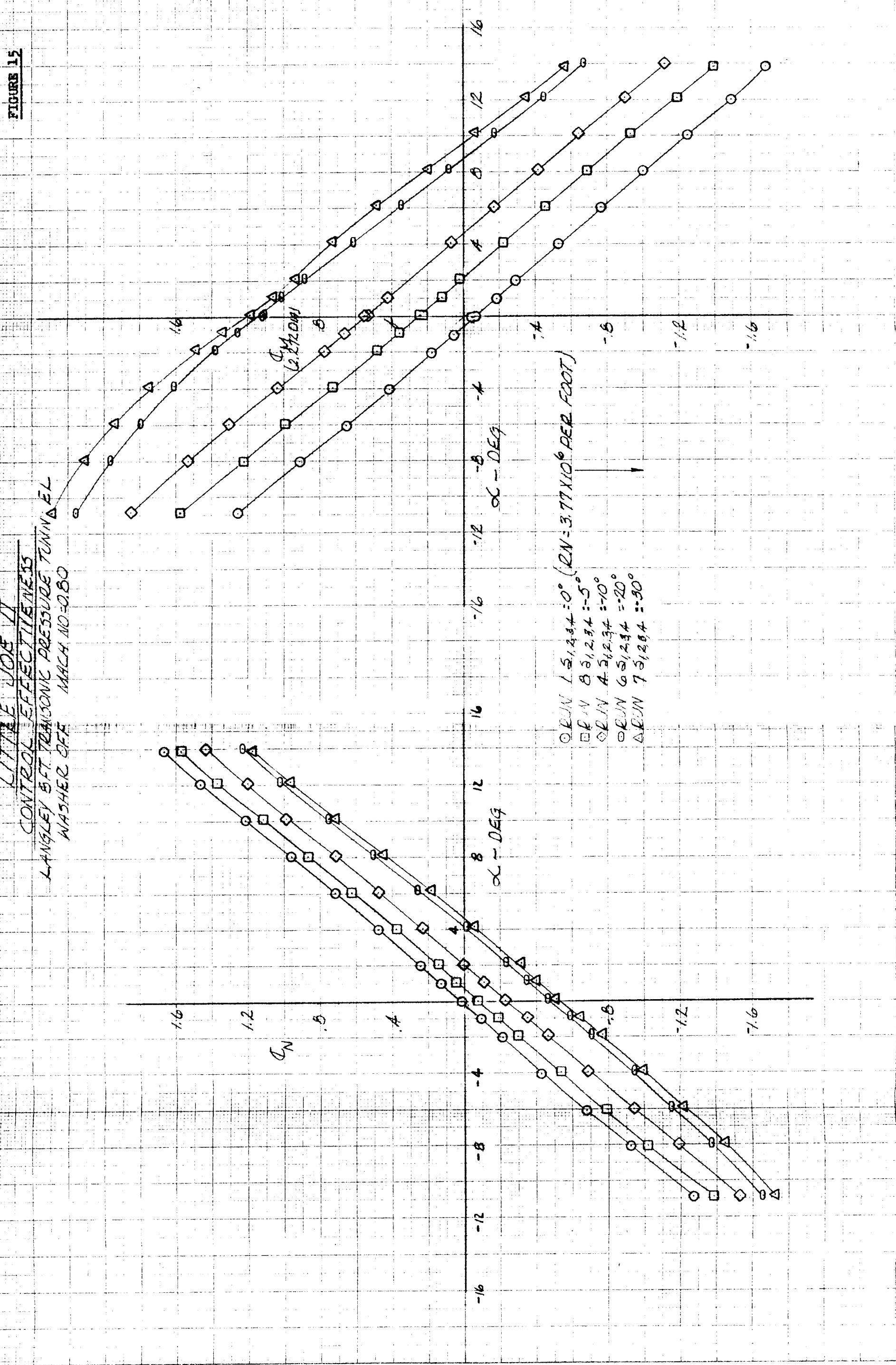


FIGURE 15

CONTRO EFFECTIVENESS

LANGLEY 5 FT TRANSONIC PRESSURE TUNNEL  
WASHER ONE MACH NO=0.80



Model 12  
19 February 1963

LITTLE JOE II

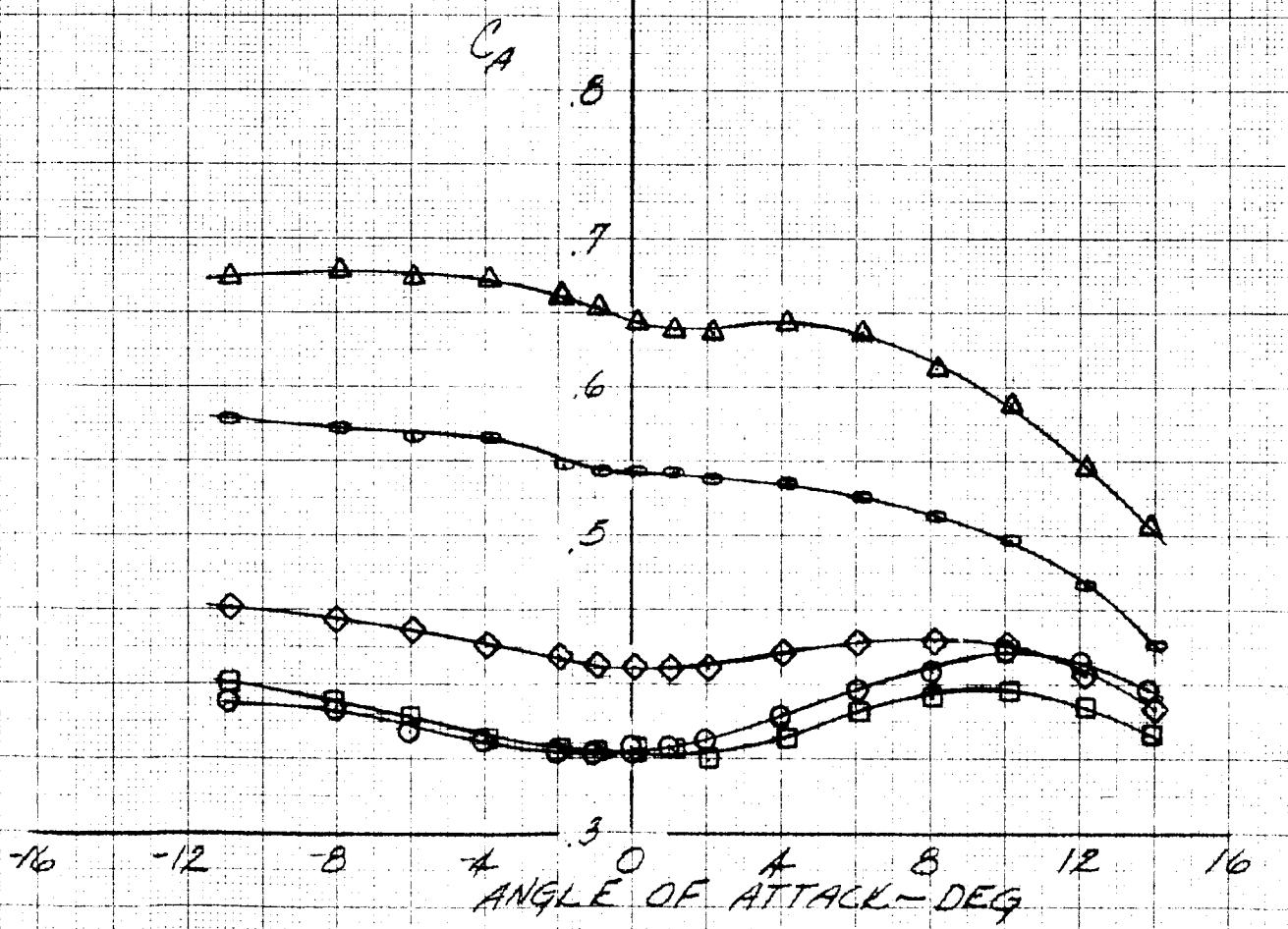
Page

25

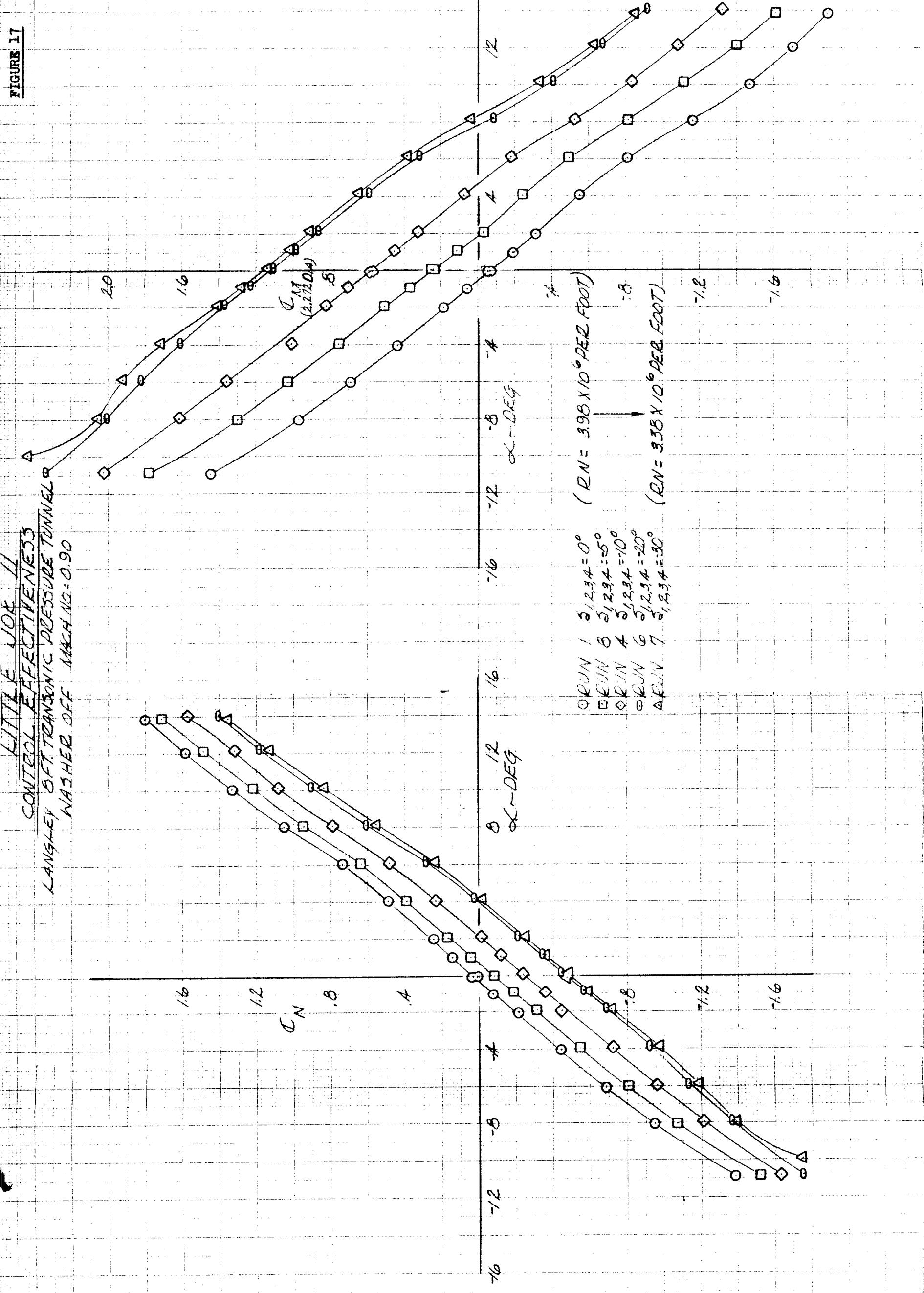
Report No. CGC-53-025  
Figure 16

CONTROL EFFECTIVENESS  
LANGLEY 8 FT TRANSONIC PRESSURE TUNNEL  
WASHER OFF  
MACH NO = 0.80

- O RUN 1  $\delta_{1,2,3,4} = 0^\circ$  (DN = 3.77 X 10<sup>6</sup> PER FOOT)  
□ RUN 8  $\delta_{1,2,3,4} = 5^\circ$   
○ RUN 4  $\delta_{1,2,3,4} = 10^\circ$   
○ RUN 6  $\delta_{1,2,3,4} = 20^\circ$   
△ RUN 7  $\delta_{1,2,3,4} = 30^\circ$



L172 E JOE 11  
CONTROCK EFFECTIVENESS  
LANGLEY 6 FT TRANSONIC PRESSURE TUNNEL  
WASHED DECK MACH NO: 0.90



Model 12  
19 February 1963

LITTLE SIDE II

Page 27  
Report No. GDC-63-4425  
Figure 18

CONTROL EFFECTIVENESS  
LANGLEY 8FT TRANSONIC PRESSURE TUNNEL  
WASHER OFF  
MACH NO = 0.90

ORDN 15<sub>1,2,3,4</sub> = 0° (RN = 3.98 x 10<sup>6</sup>)  
ORDN 55<sub>1,2,3,4</sub> = -5° PER FOOT  
ORDN 45<sub>1,2,3,4</sub> = -10°  
ORDN 65<sub>1,2,3,4</sub> = -20°  
ORDN 75<sub>1,2,3,4</sub> = -30° (RN = 3.38 x 10<sup>6</sup>)  
PER FOOT

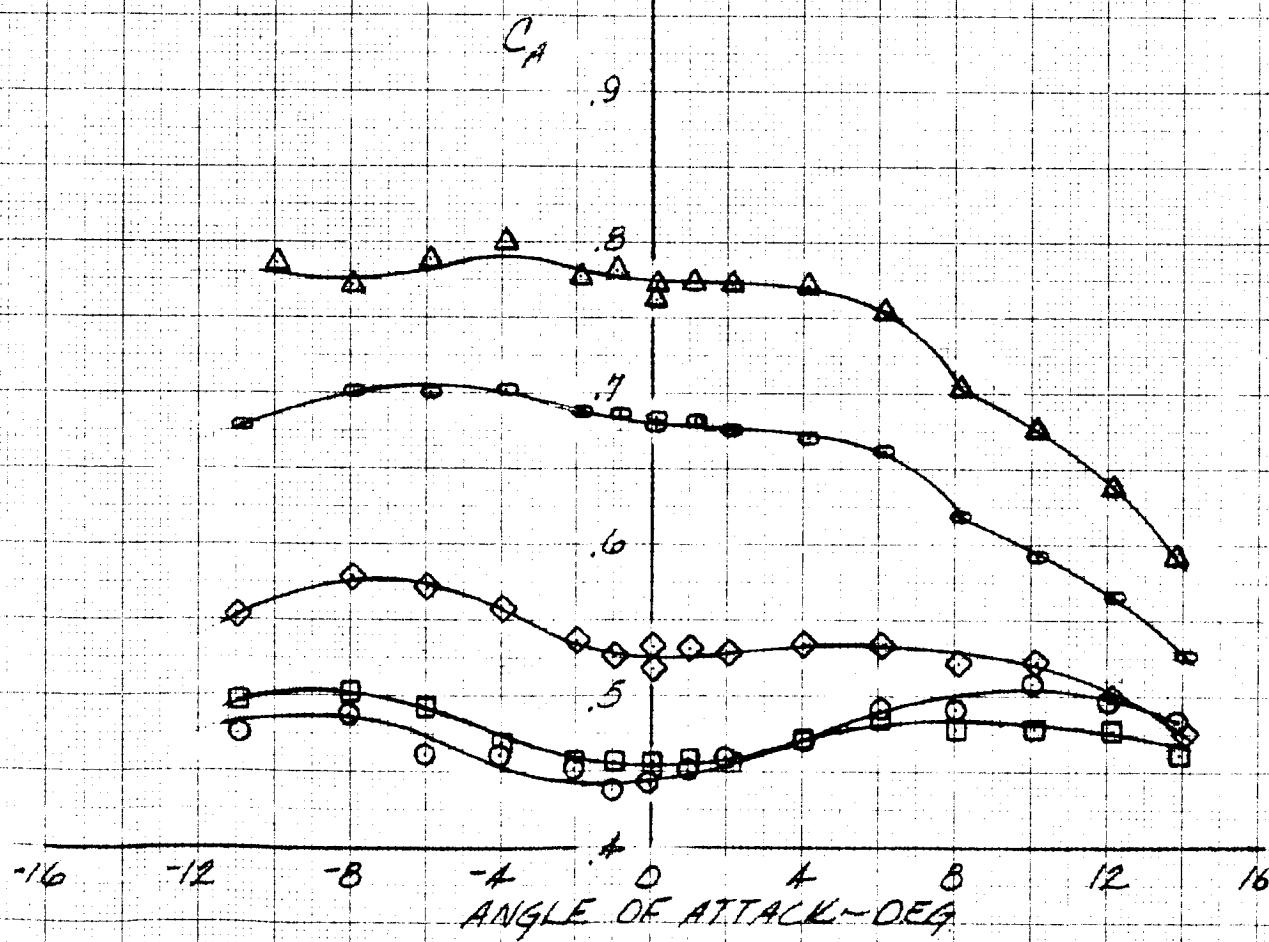
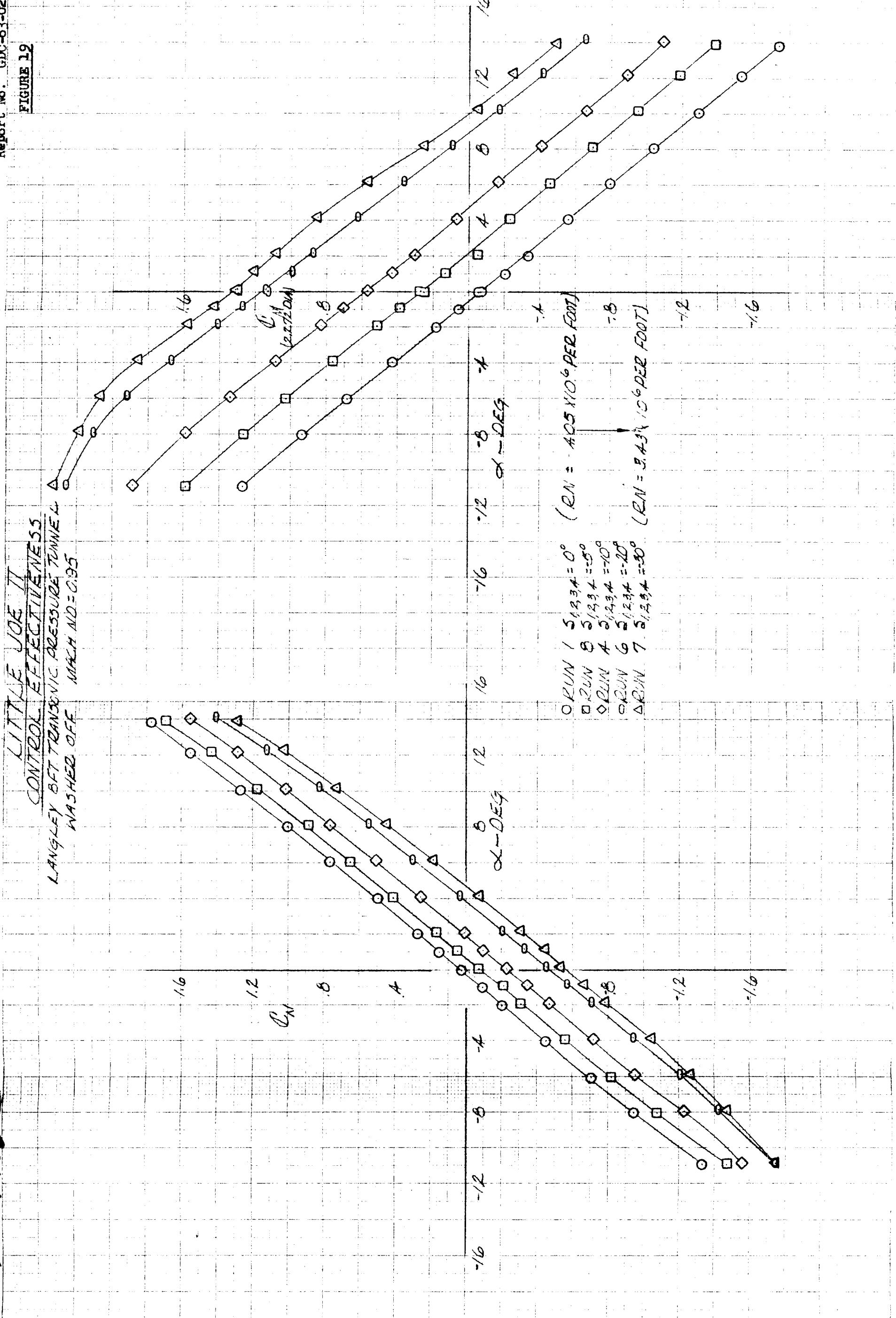


FIGURE 12

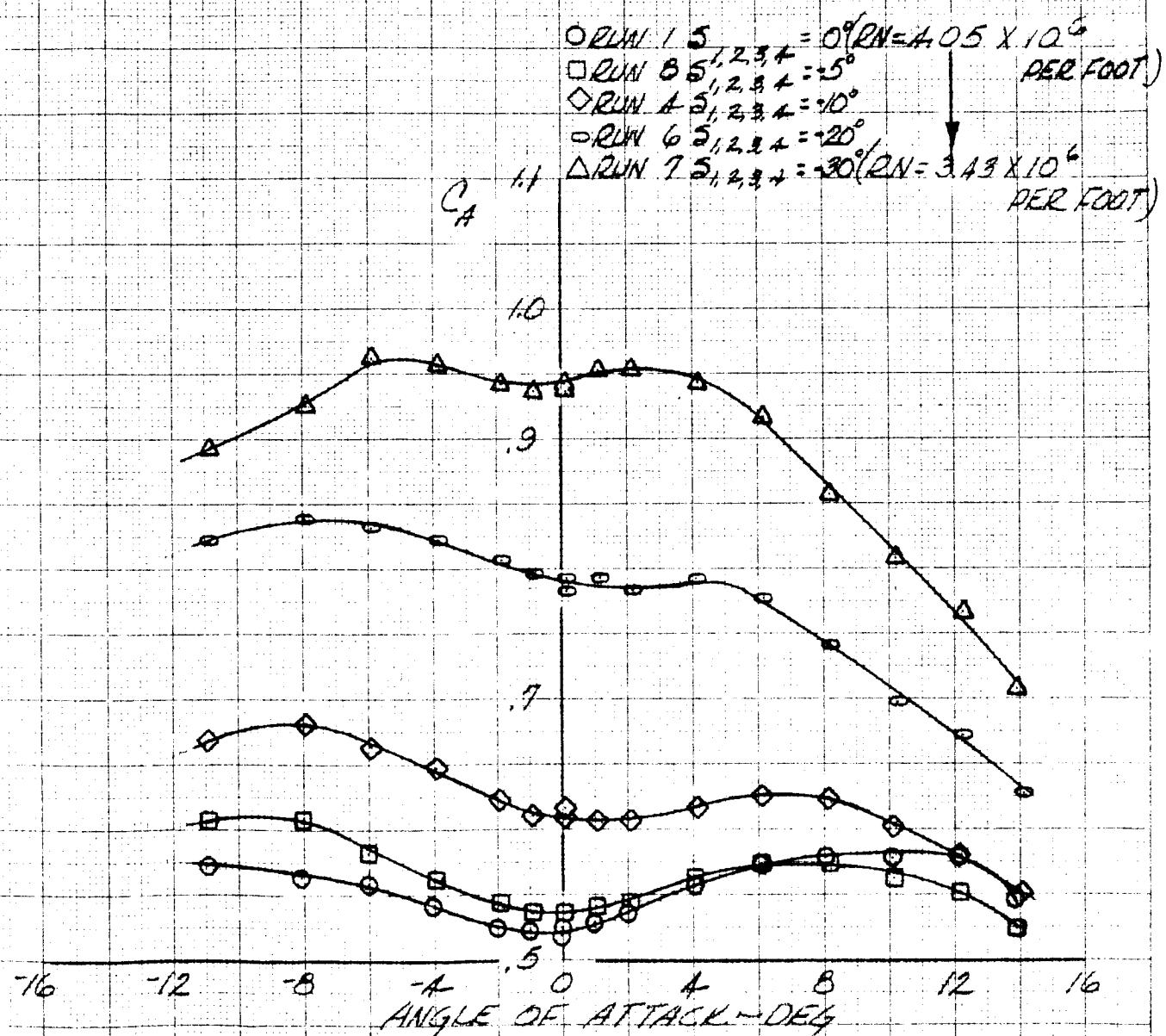


Model 12  
19 February 1963

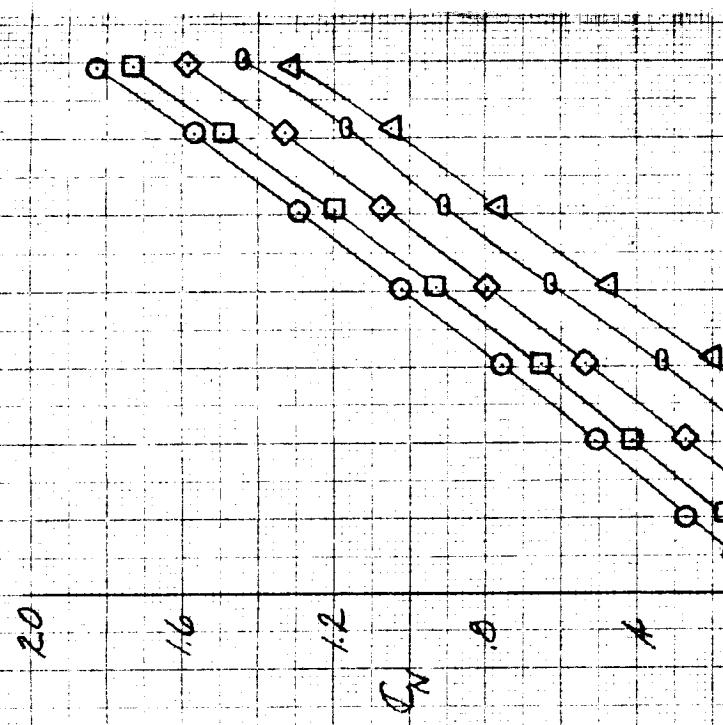
LITTLE JOE II

Page 29  
Report No. GIC-63-025  
Figure 20

CONTROL EFFECTIVENESS  
LANGLEY 8 FT. TRANSONIC PRESSURE TUNNEL  
WASHER OFF MACH NO.=0.95



CONTOUR EFFECTIVENESS  
ANGLE OF TRANSonic DESIgN TUNNEL  
WATER DEZ MACH NO=100



2.0

1.6

1.2

.8

.4

0

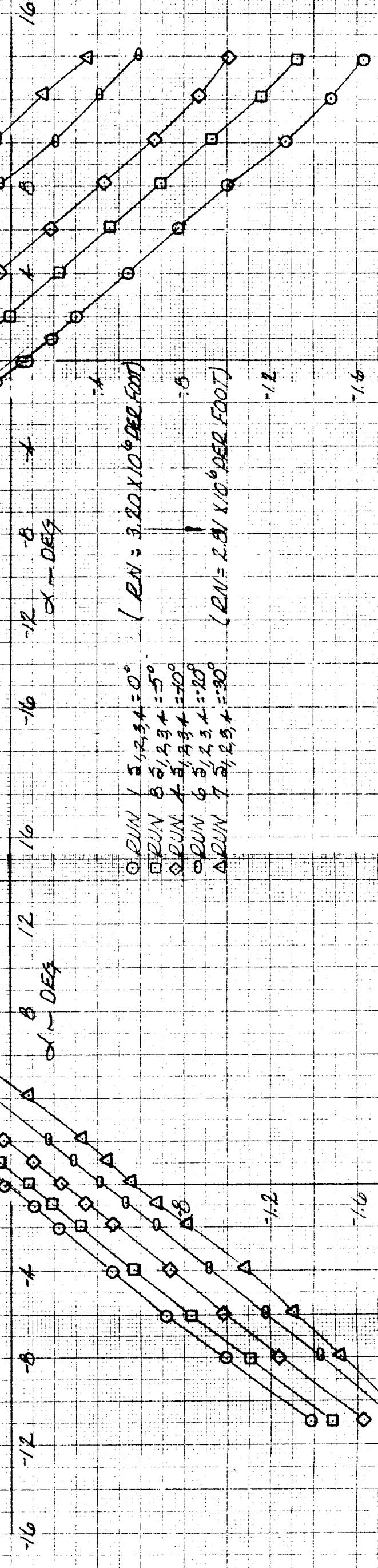
-4

-8

-12

-16

angle of attack



16

12

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4

0

-4

-8

-12

-16

-16 -12 -8 -4 DEG

angle of attack

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4

8

12

16

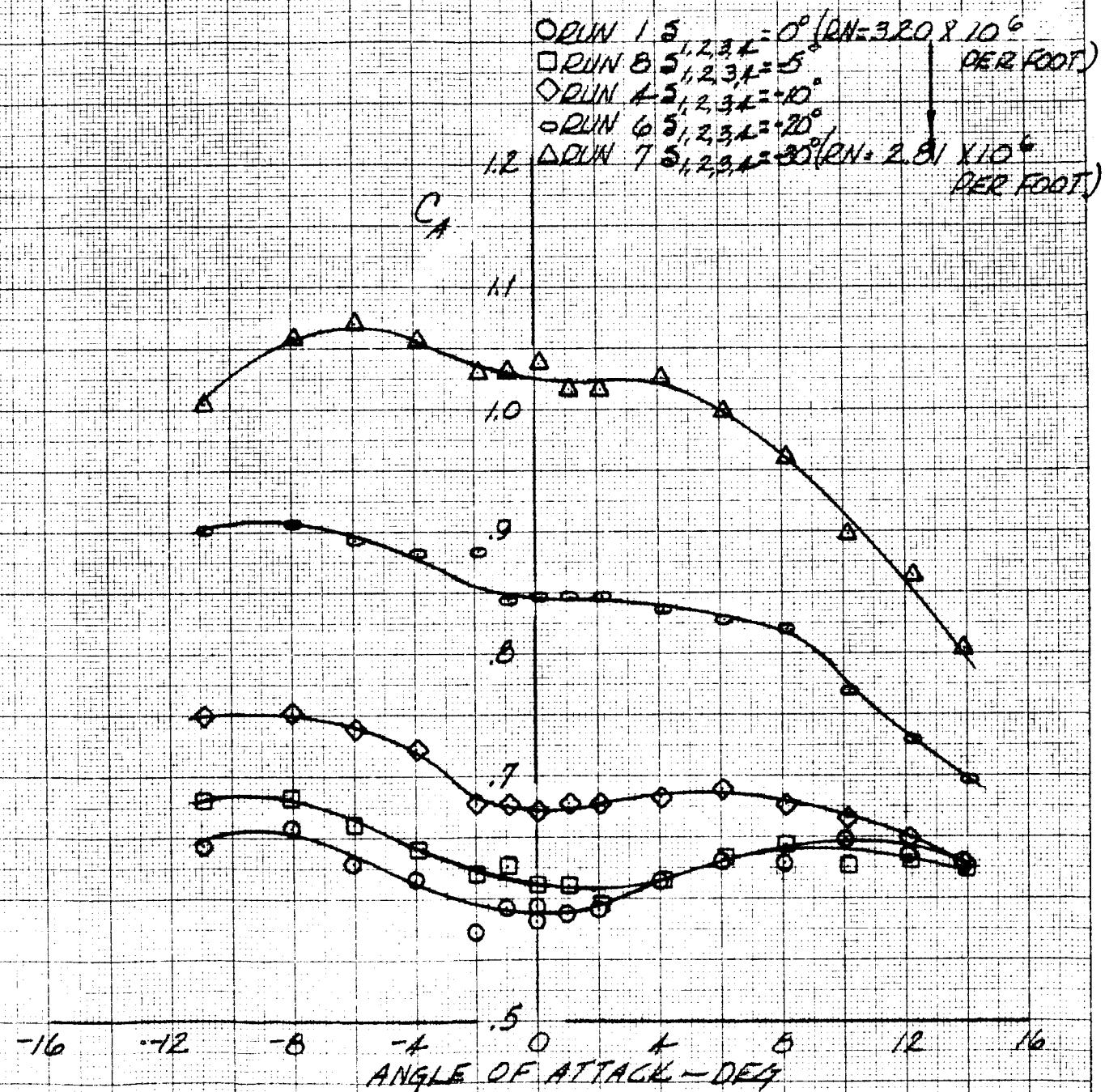
angle of attack

Model 12  
19 February 1963

LITTLE JOE II

Page 31  
Report No. GDO-63-026  
Figure 22

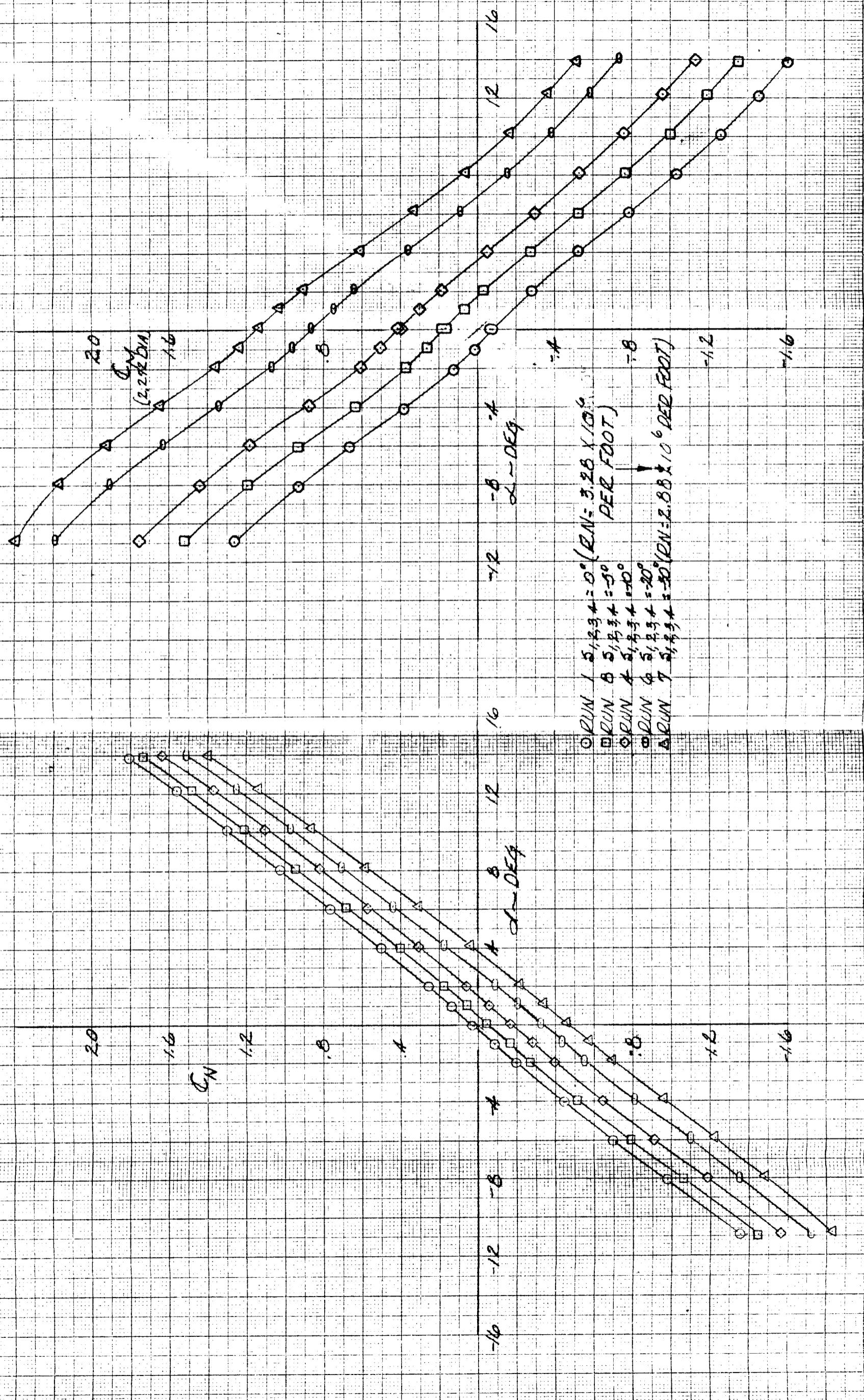
CONTROL EFFECTIVENESS  
LANGLEY CFT TRANSonic PRESSURE TUNNEL  
WASHER OFF MACH NO = 1.00



GENERAL DYNAMICS CORP.

Model 12 Date 19 February 1963

PICTURE 23



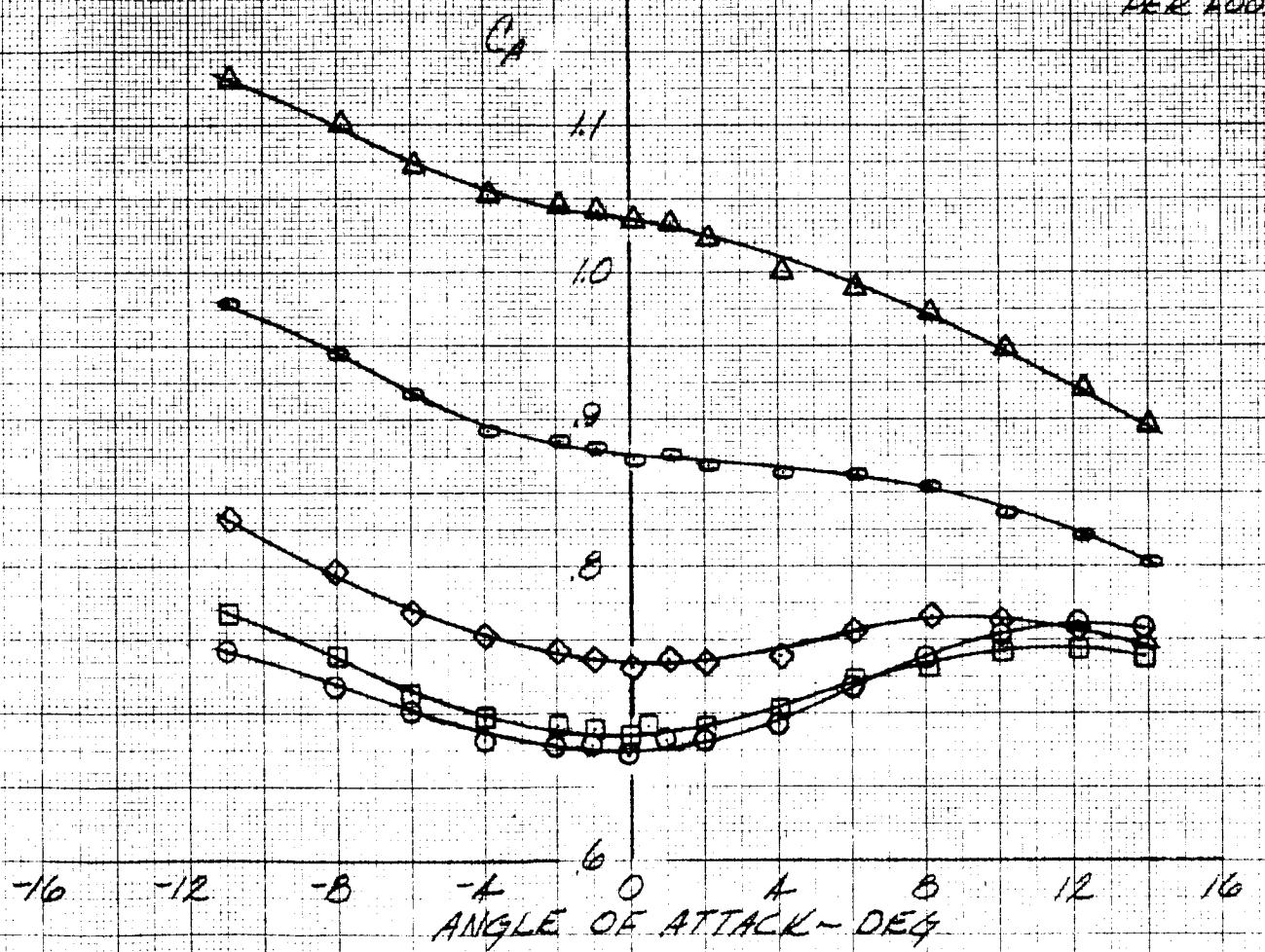
Model 12  
19 February 1963

LITTLE FILE 11

Page 33  
Report No. 60-63025  
Figure 24

CONTROL EFFECTIVENESS  
LANGLEY BET TRANSonic PRESSURE TUNNEL  
WASHER OFF MACH NO=1.20

ORUN 1 5  $\Delta$   $0^\circ$   $10\% 3.28 \times 10^6$   
ORUN 3 5  $\square$   $1,2,3,4 = 5^\circ$  PER FOOT  
ORUN 4 5  $\diamond$   $1,2,3,4 = 10^\circ$   
ORUN 6 5  $\circ$   $1,2,3,4 = 20^\circ$   
ORUN 7 5  $\triangle$   $1,2,3,4 = 30^\circ$   $(RN_1 2.08 \times 10^6)$   
PER FOOT



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ENERGY DYNAMICS CONVENTIONAL

CONT'D EFFECTIVE 7-5  
LANGLEY WATERTOWER PLAN SUPERSONIC TUNNEL  
WATER LEVEL MACH NO = 1.57

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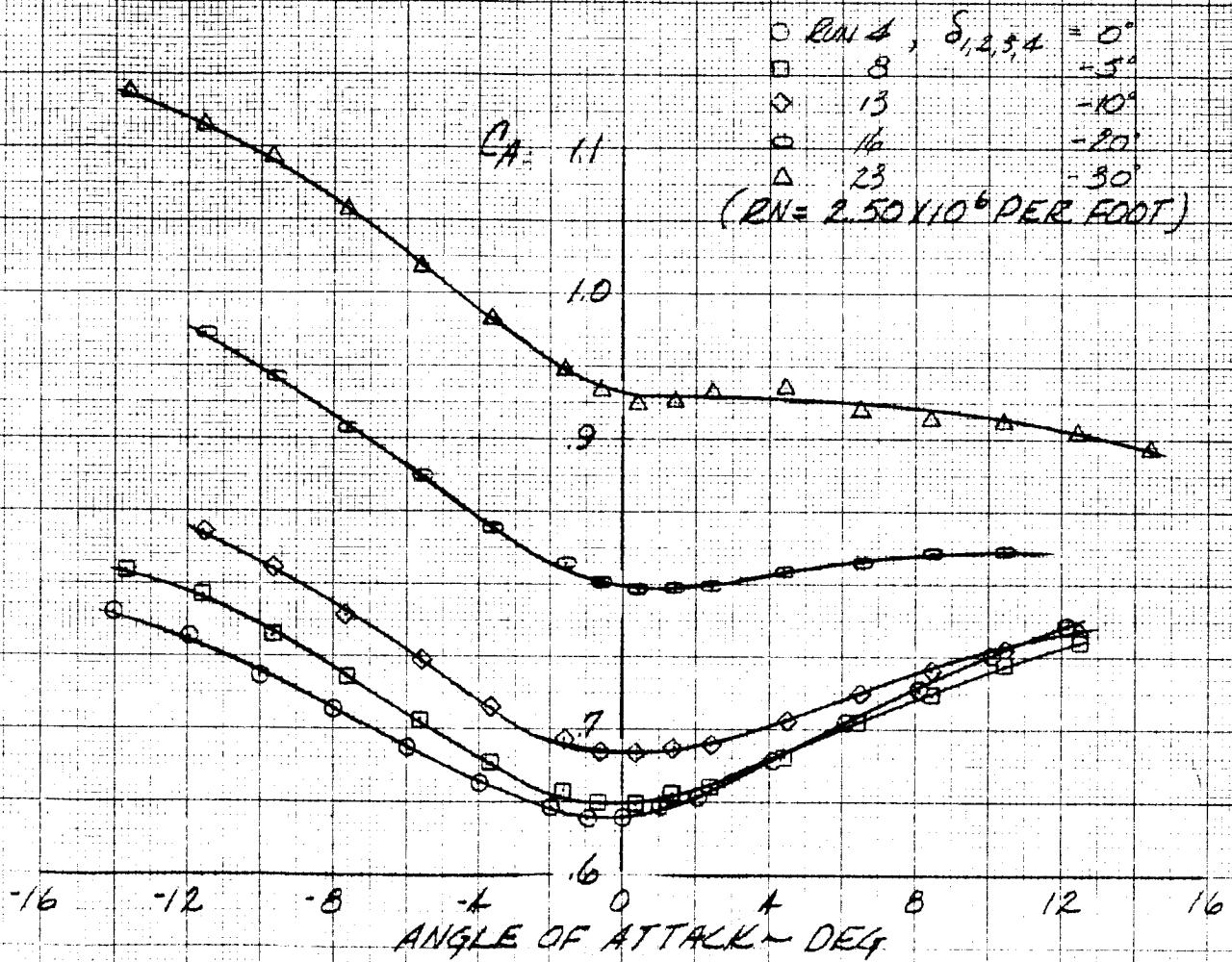
A graph with the y-axis labeled  $C_m$  and the x-axis labeled  $t/t_0$ . The y-axis has a scale from 0 to 2.0 with increments of 0.2. The x-axis has a scale from 0 to 1.0 with increments of 0.2. Two curves are plotted: one for  $\beta = 0.4$  (solid line with open circles) and one for  $\beta = 0.7$  (dashed line with open triangles). Both curves start at (0,0) and end at (1.0, 2.0). The curve for  $\beta = 0.4$  is steeper than the curve for  $\beta = 0.7$ .

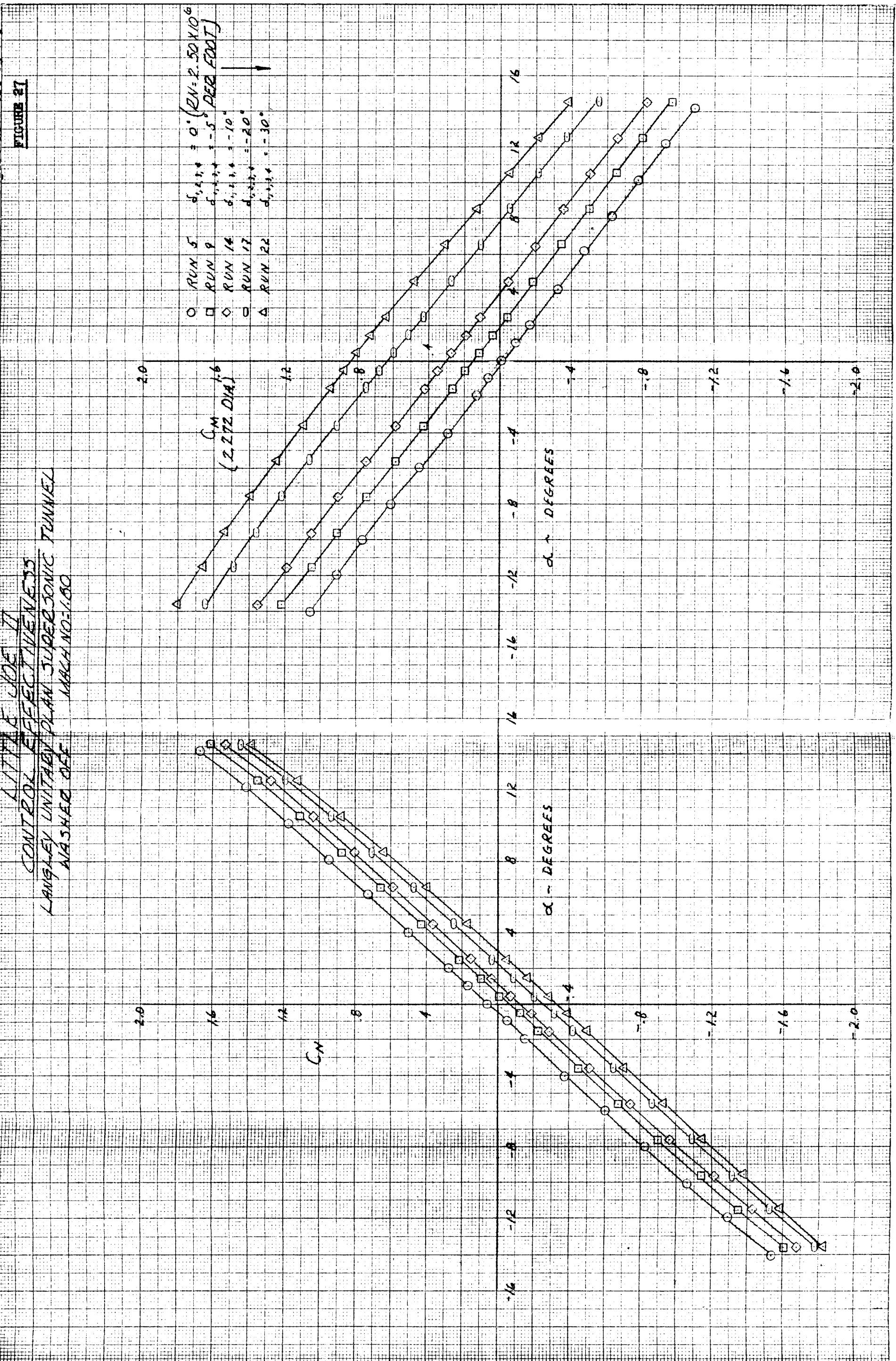
O	RUN 4	$d_1, f, 3, 4$	$= 0^\circ$	( $D11 = 2.50 \text{ m}^3$ )
O	RUN 8	$S, d, 3, 4$	$= -5^\circ$	PER Foot
O	RUN 13	$d_3, f, 3, 4$	$= -10^\circ$	
O	RUN 16	$d_3, f, 2, 1$	$= -20^\circ$	
O	RUN 21	$d_1, f, 2, 1$	$= -20^\circ$	

FIGURE 25

Model 102  
19 February 1963

LITTLE JOE II

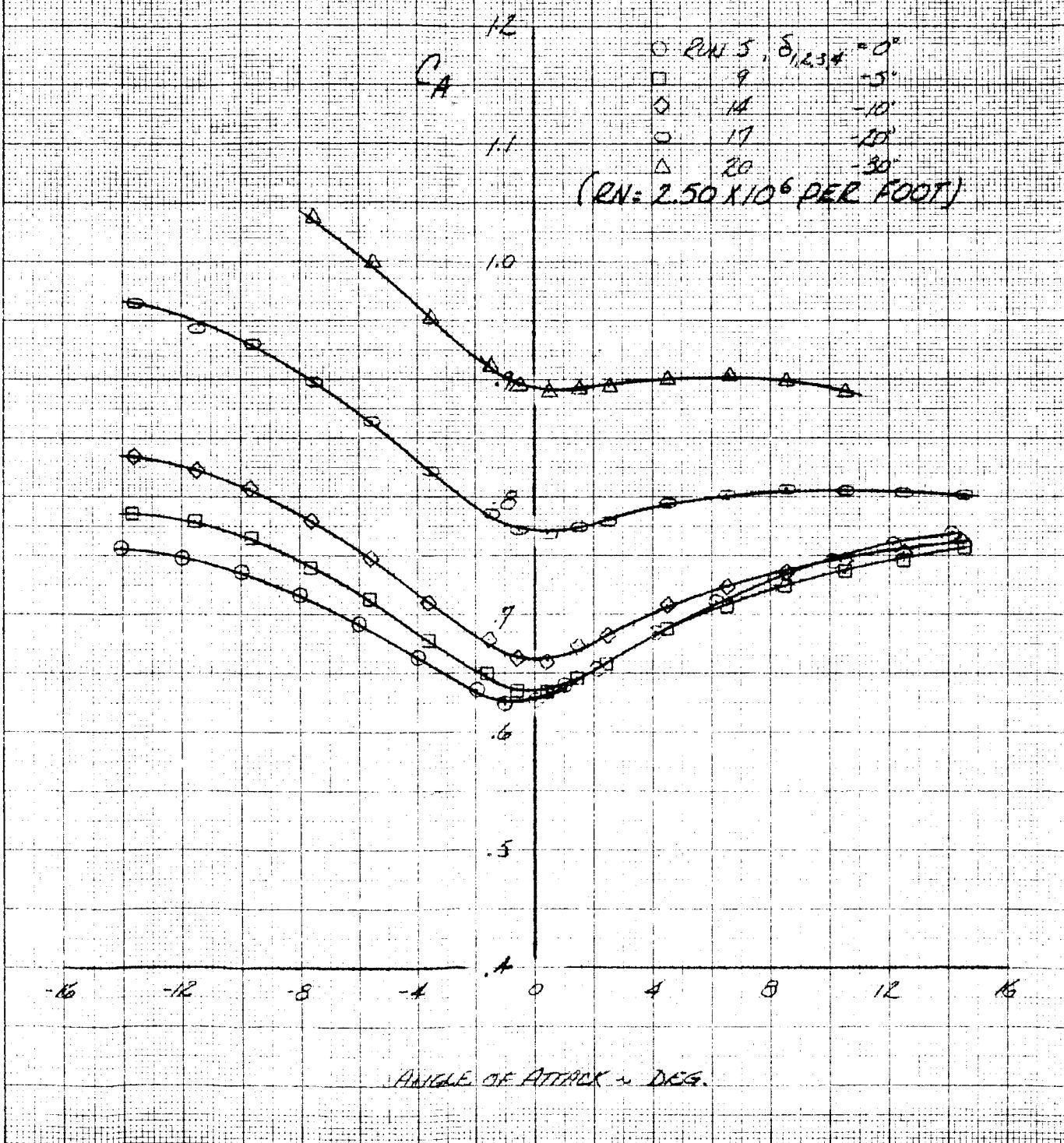
Page 35  
Report No. ADO-63-625  
Figure 26CONTROL EFFECTIVENESS  
LANGLEY UNITARY PLATE SUPERSONIC TUNNEL  
WASHER OFF MACH NO=1.51



Model 12  
19 February 1963

LITTLE JET II

CONTROL EFFECTIVENESS  
LANGLEY INERTIAL DRAIN SUPERSONIC TUNNEL  
WASHER OFF                            MACH NO. 1.80

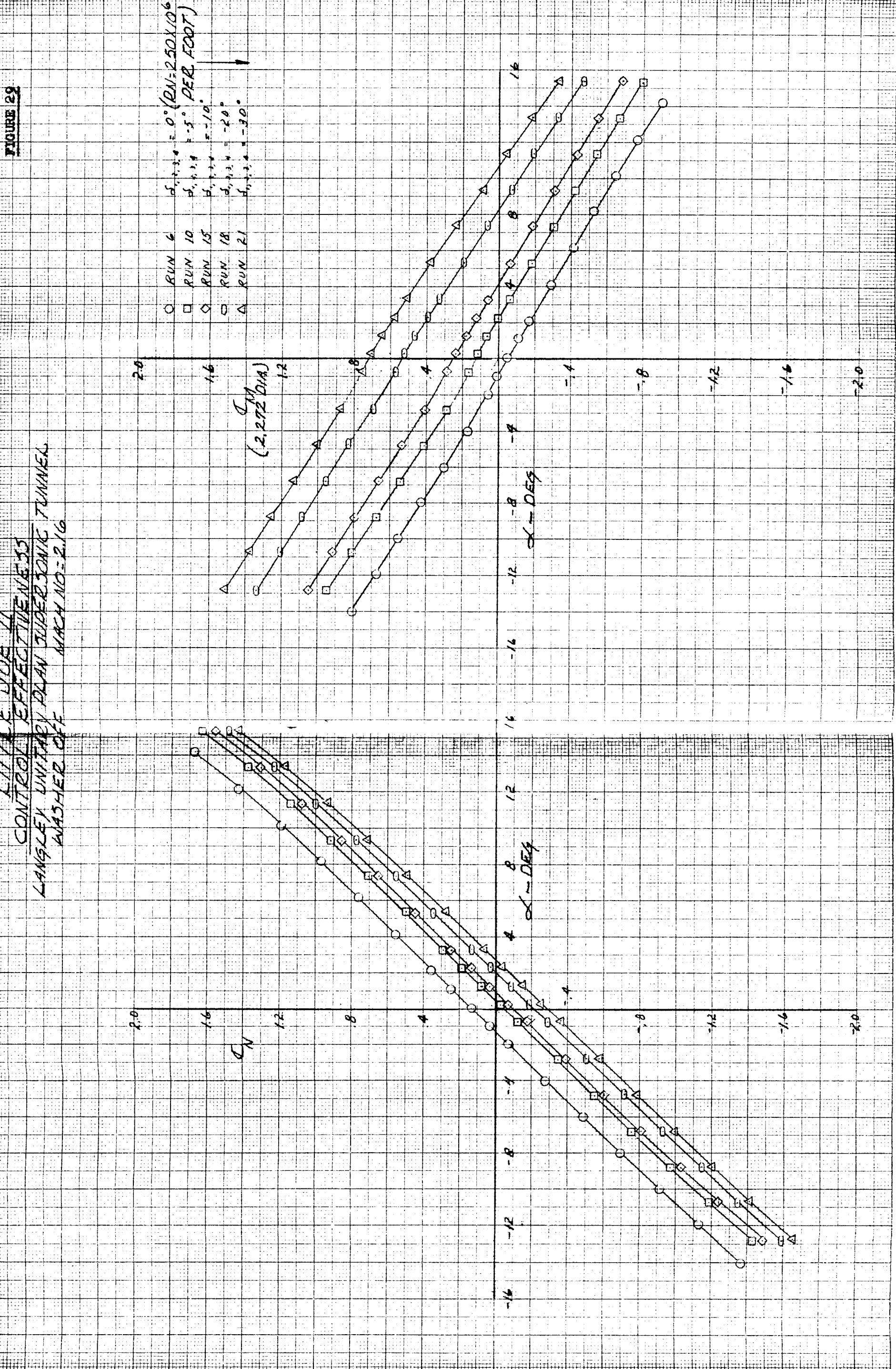


Model 12 Date 19 February 1963

(111111) G.E. FRAMME CORNELL

Page 38 Report No. GDC-63-025

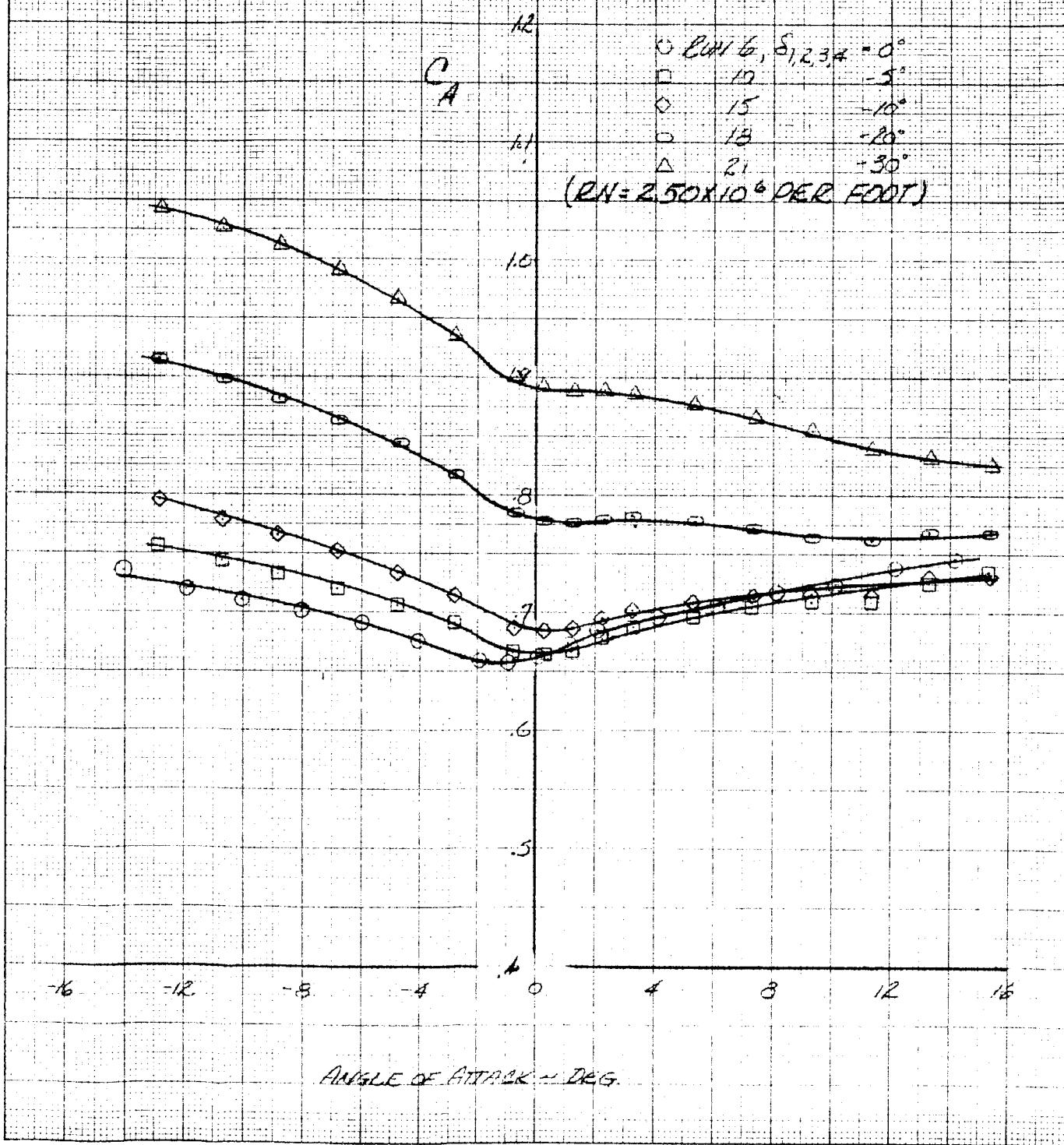
CONTINUATION OF EFFECTIVE TENSILE STRENGTH TESTS  
LONGEST DIA. OF PLASTIC ZONE 10 = 2.16



~~Model 12~~  
19 February 1963

LITTLE 10E11

CONTROL EFFECTIVENESS  
LANGLEY UNITARY PLATE SUPERSONIC TUNNEL  
WASHER OFF MACH NO: 2.16

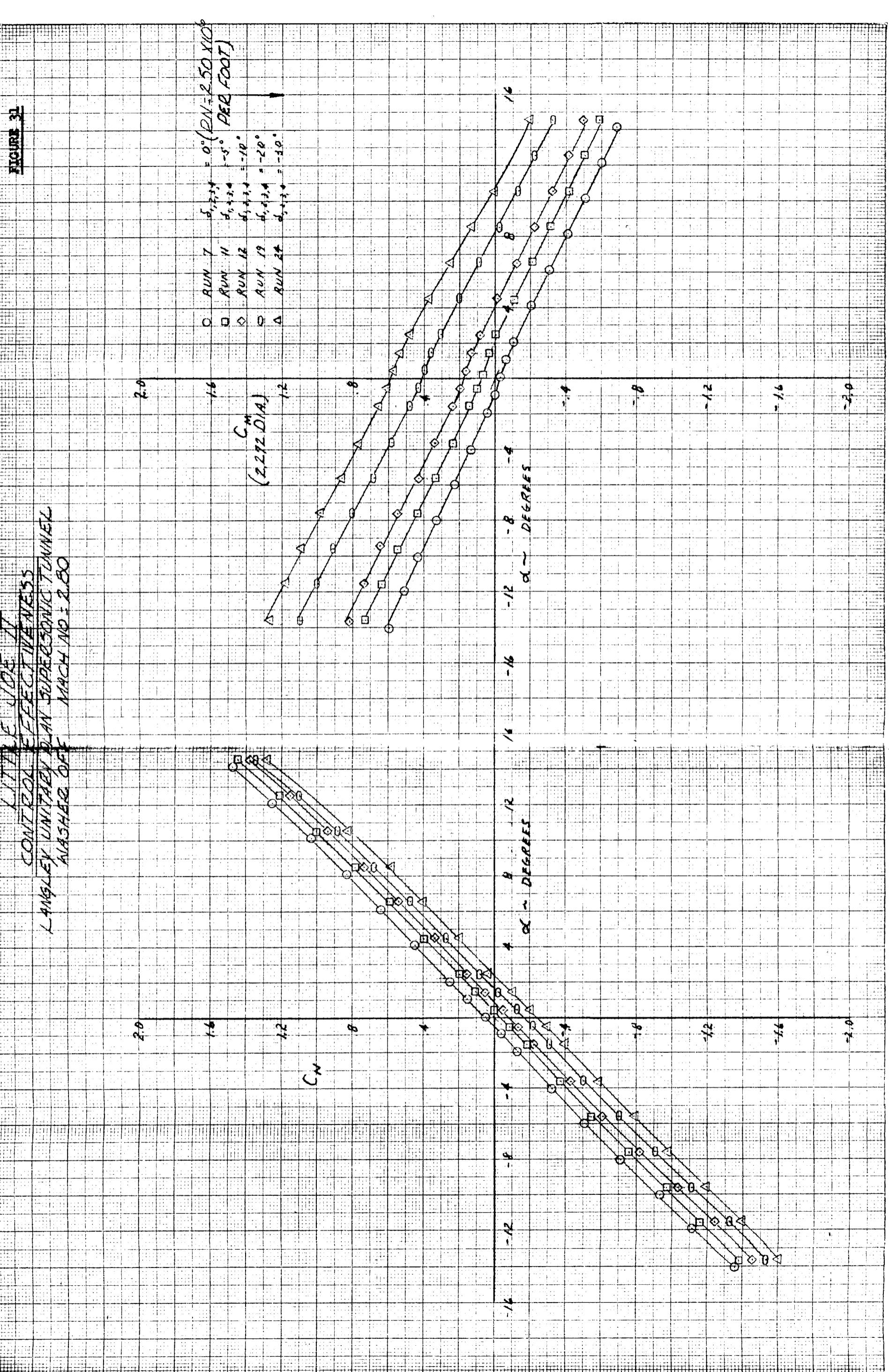


Model 12  
Date 19 February 1963

(11111)  
DYNAMICS SONAIR

Page 40 Report No. GDC-63-025

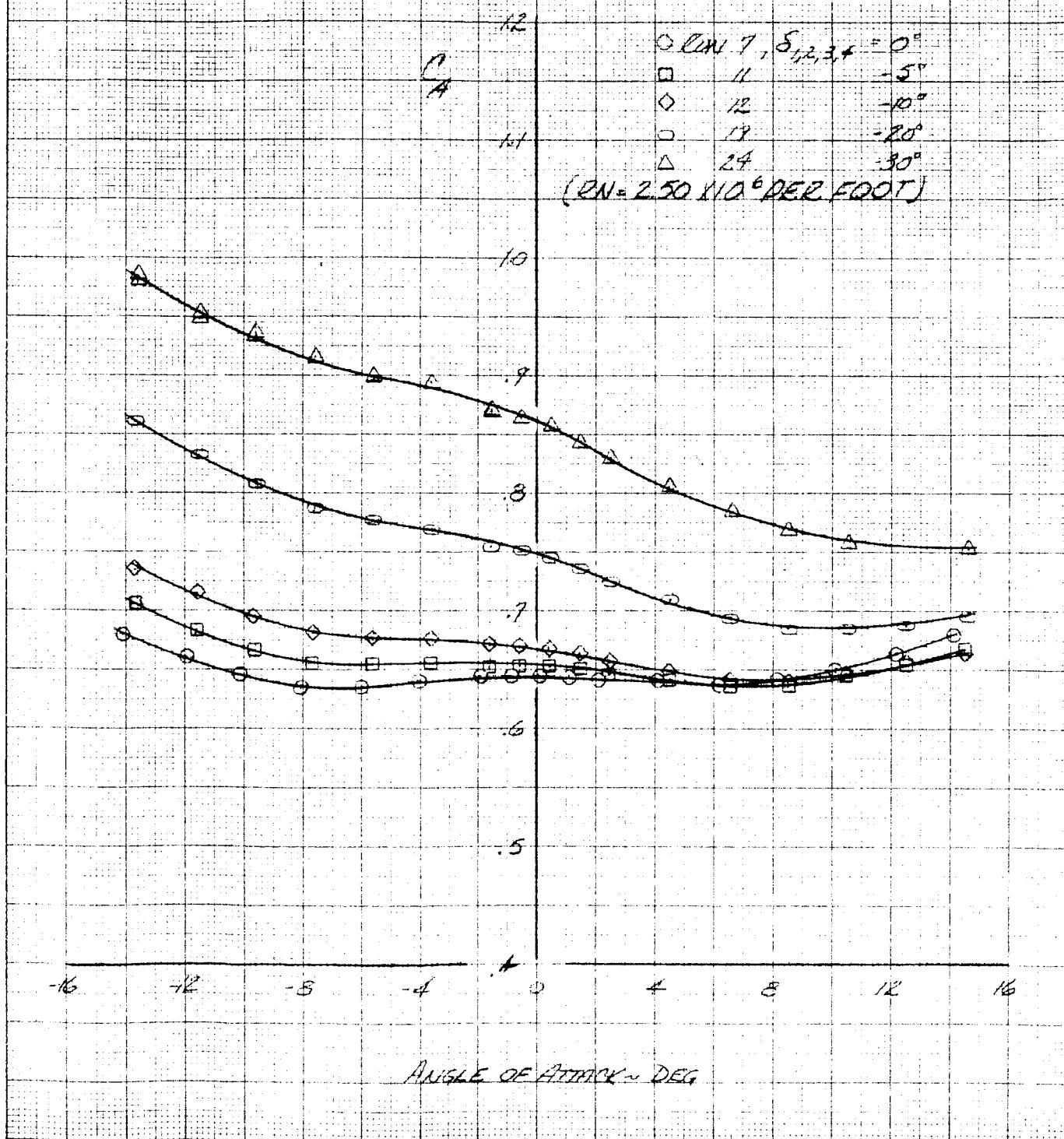
CONT'D  
EFFECTIVENESS  
ANGLE OF ATTITUDE  
MACH 0.542 DIA MACH 10 = 2.30



Model 12  
19 February 1963Page  
Report No. GDC-63-025  
Figure 32

LITTLE WIDE II

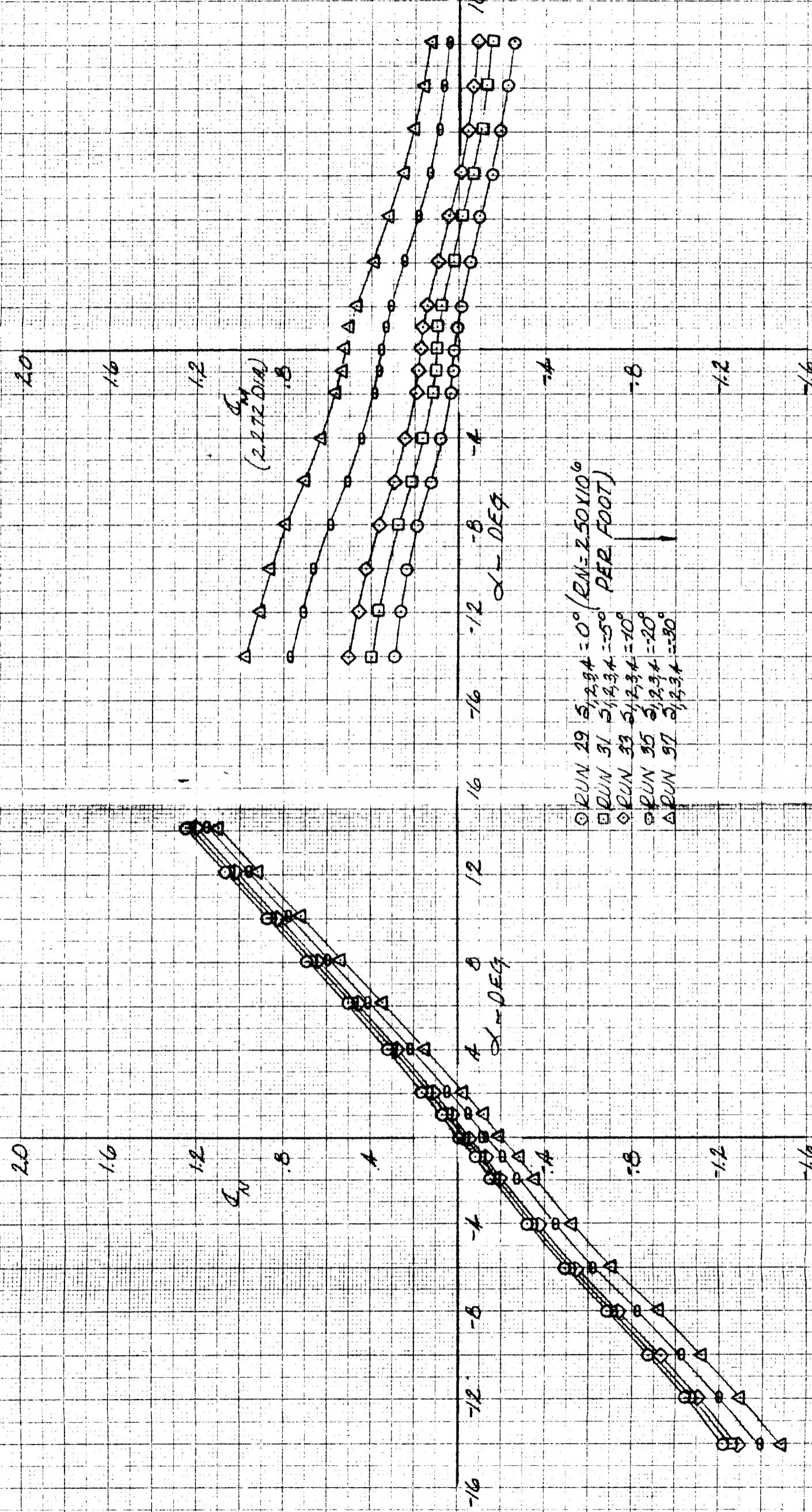
CONTROL EFFECTIVENESS  
LANGLEY UNITARY PLATE SUPERSONIC TUNNEL  
WASHER OFF  
MACH NO. 2.00



GENERAL DYNAMICS CONVAIR

Model 12 Date 19 February 1963

CONTROLLED EFFECTIVELESS  
LANGLEY UNITARY PLANT SUPERSONIC TUNNEL  
WASHER OFF MACH NO = 3.36

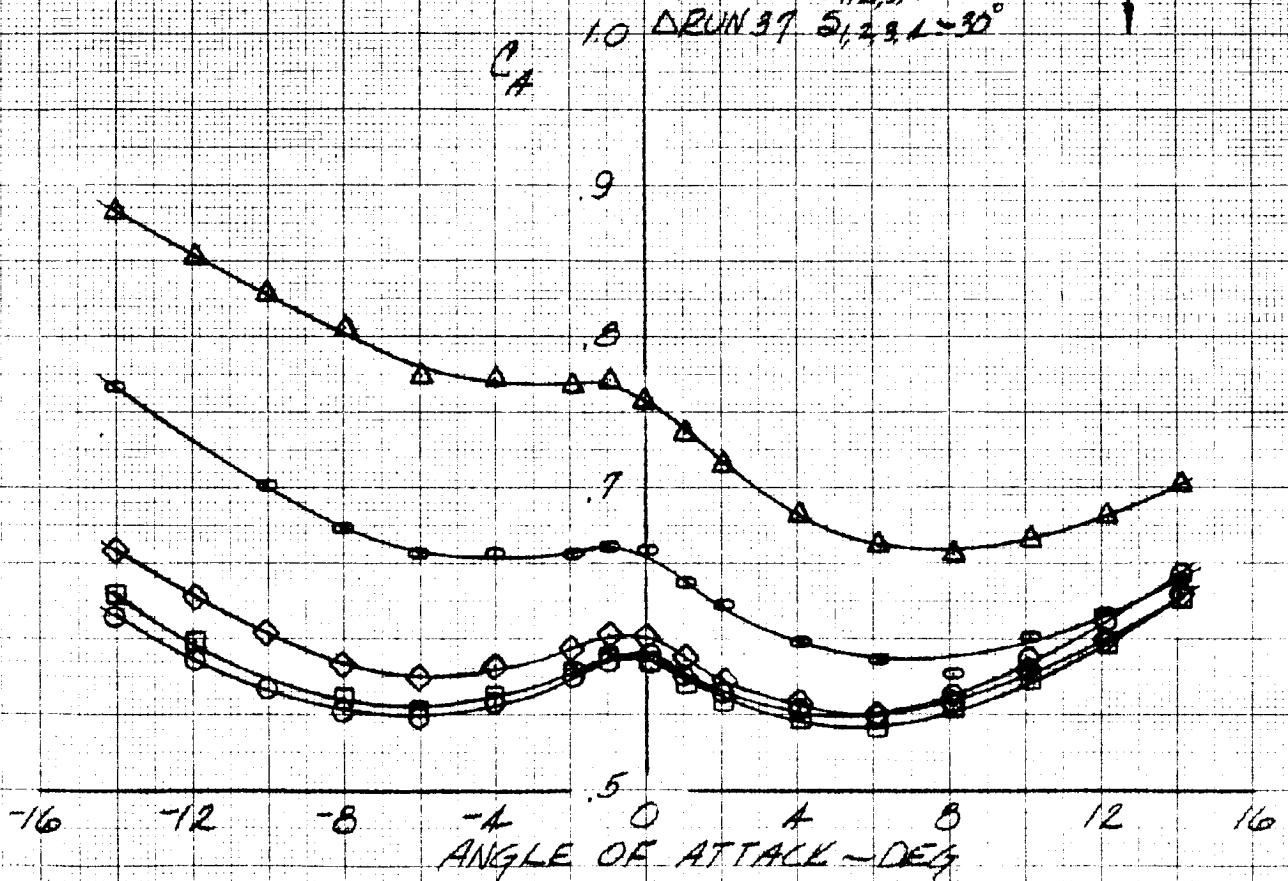


Model 12  
19 February 1963LITTLE JOE II

CONTROL EFFECTIVENESS  
LANGLEY UNITARY PLATE SUPERSONIC TUNNEL  
WASHER OFF      MACH NO = 3.86

ORUN 29  $5,2,3,4=0^\circ$  (RN =  $2.50 \times 10^6$ )  
 ORUN 31  $5,2,3,4=5^\circ$   
 ORUN 33  $5,2,3,4=10^\circ$   
 ORUN 35  $5,2,3,4=20^\circ$   
 ORUN 37  $5,2,3,4=30^\circ$

PER FOOT

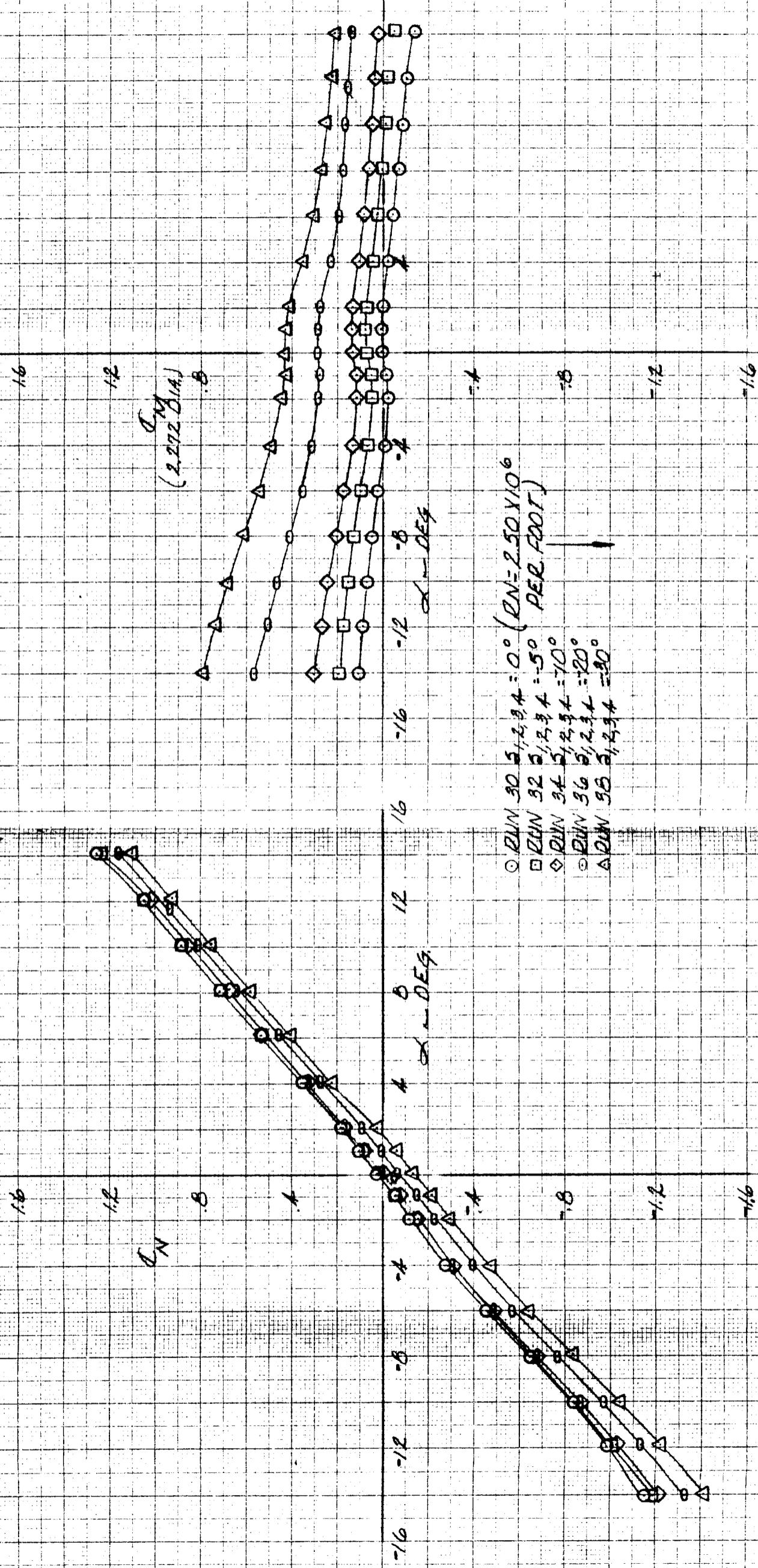


Model 12  
Date 19 February 1963

(11111) GSE NERA DYNAMICS CONVAIR

Page 44  
Report No. GDC-63-025

CONTOUR EFFECTIVE TUNNEL  
LANGEVY UNDULATION PLAN 310030 NO. 1.05  
WALLS OF MEGAS NO. 1.05



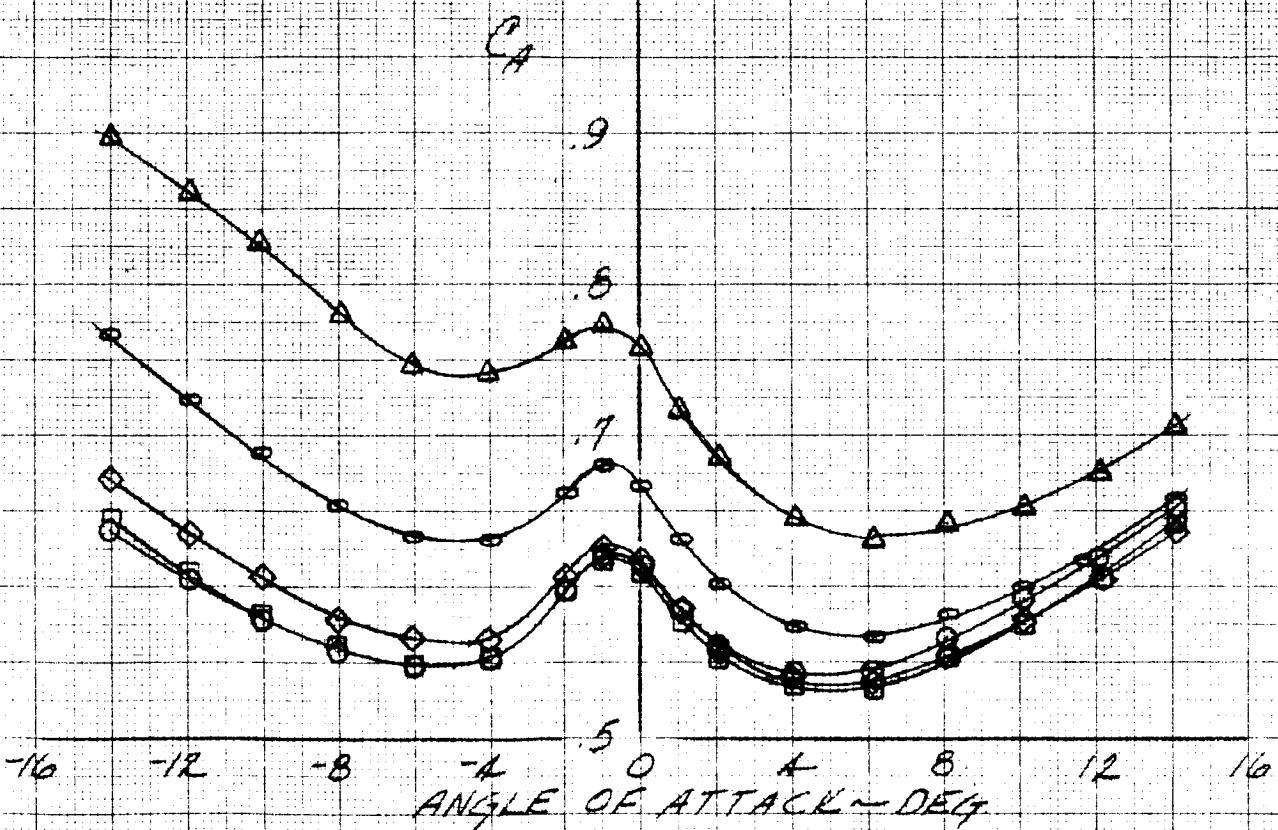
Model 11  
19 February 1963Page 45  
Report No. SD-5-025  
Figure 36

## LITTLE JOE VI

CONTROL EFFECTIVENESS  
LANGLEY UNITARY PLAN SUPER SONIC TUNNEL  
WASHER OFF      MACH NO = 4.65

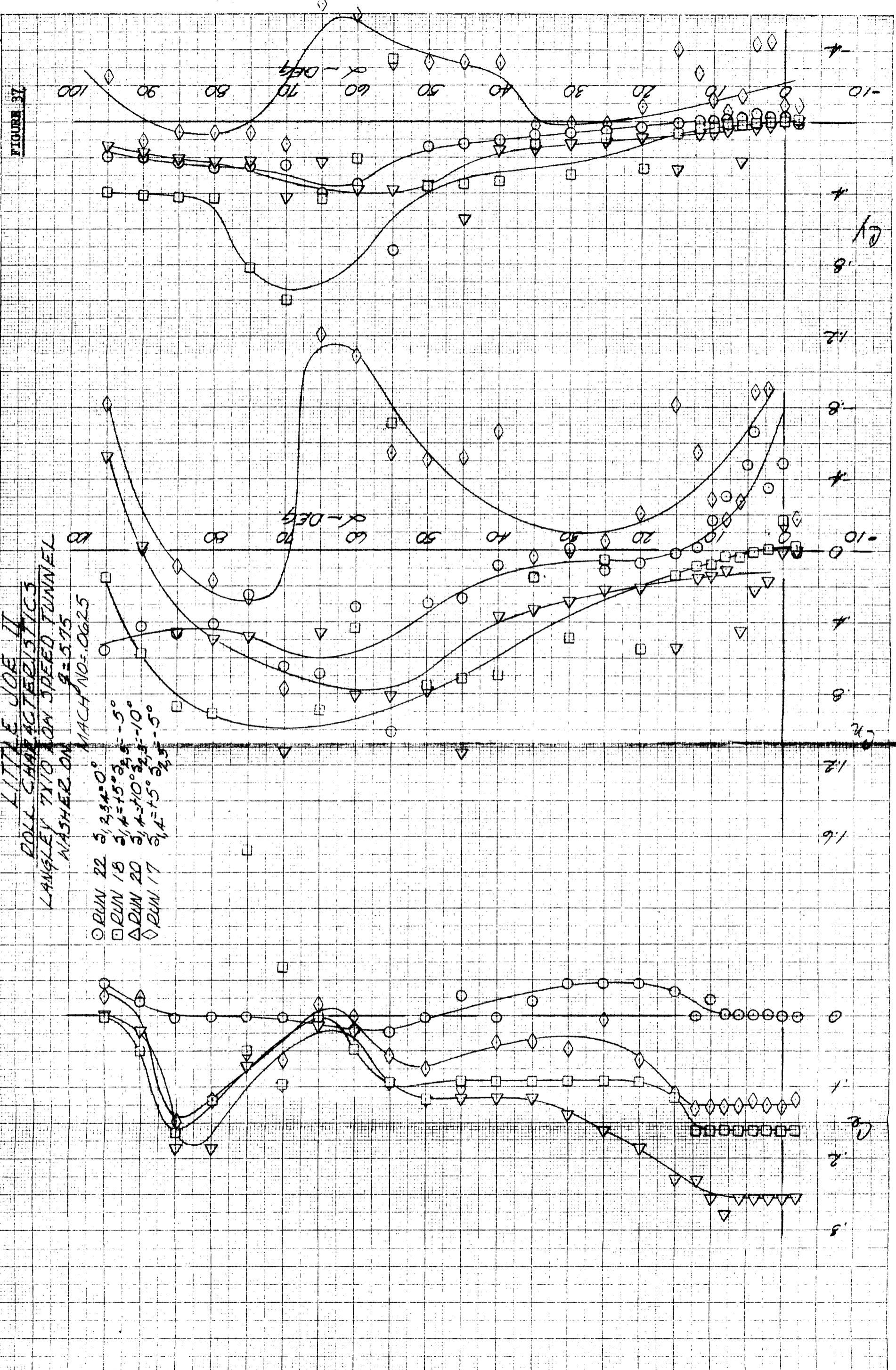
OPEN 30 S, 2,3,4 = 0° /  $RN = 2.50 \times 10^{-6}$   
 □ RUN 32 S, 2,3,4 = 5°  
 ○ RUN 34 S, 2,3,4 = 10°  
 - RUN 36 S, 2,3,4 = 20°  
 Δ RUN 38 S, 2,3,4 = 30°

(DEG FOOT)



GENERAL DYNAMICS CONVAIR

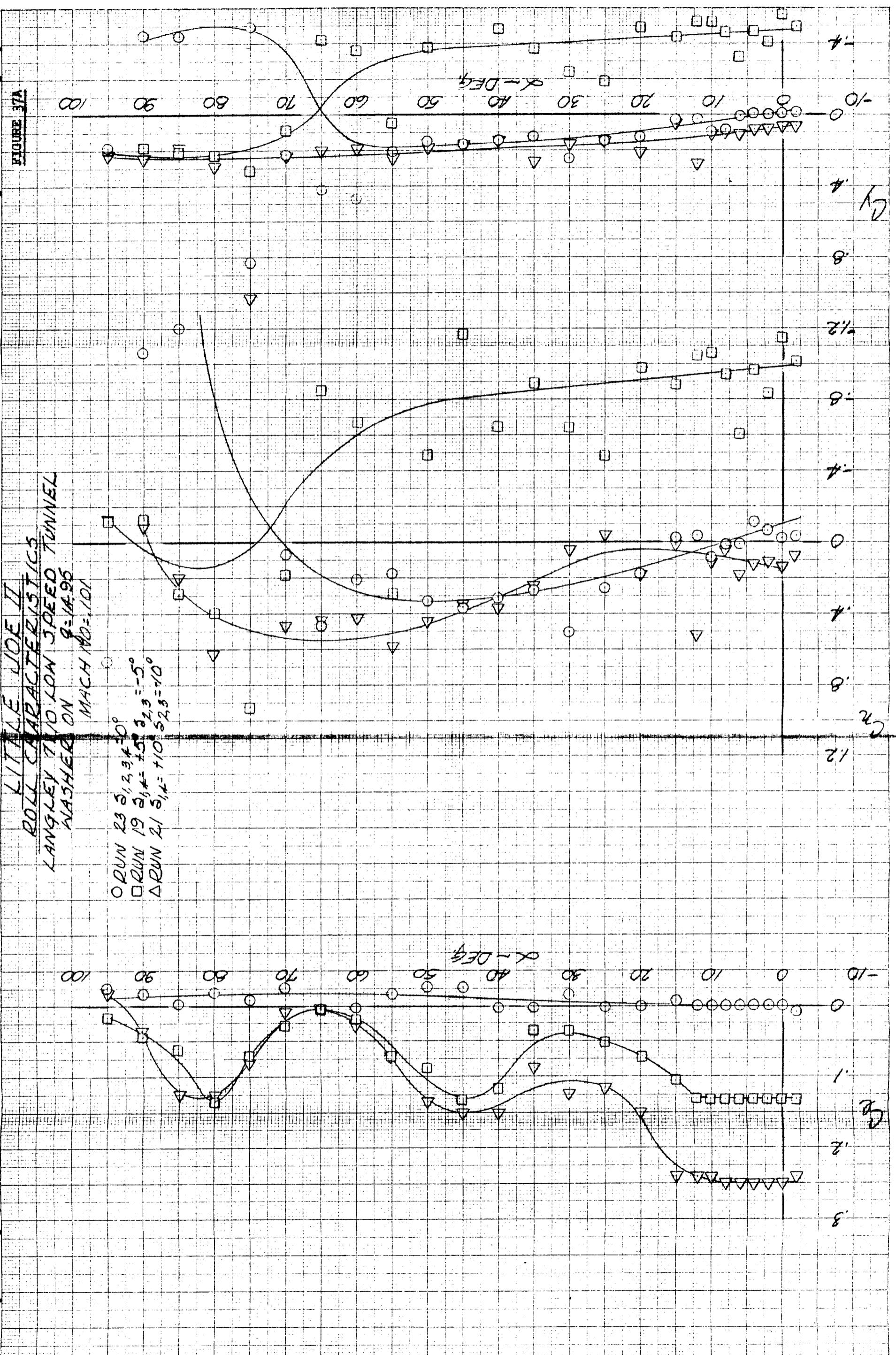
Model 12 Date 19 February 1963



DYNAMICS · CONVAIR  
GENERAL

~~ROLL CHARACTERISTICS  
ANGLEY 70 LOW SPEED TUNNEL  
WASHER ON g=14.95~~

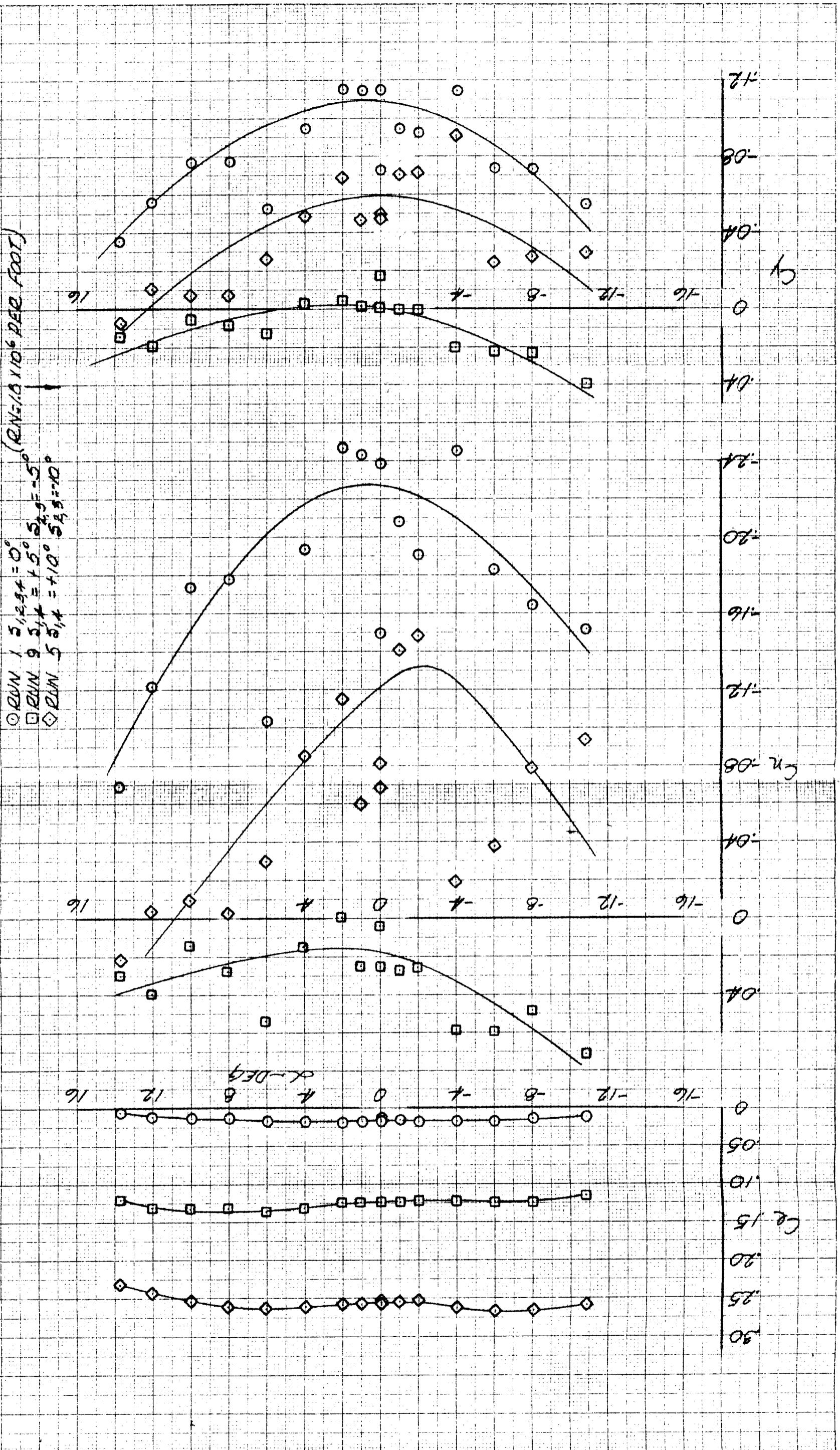
□ RUN 23 5:23 34 -10°  
 □ RUN 19 5:45 32,3 = -5°  
 △ RUN 24 5:45 32,3 = +10°



COLL CIRCULAR TUNNEL  
LANGLEY BFT TRANSOMIC PRESSURE OFF  
WASHER OFF MACH NO = 0.30

$$\begin{aligned} \text{Q EWN } 1 & \quad 5^{\circ} 12' 34'' = 0^{\circ} \\ \text{Q EWN } 2 & \quad 5^{\circ} 14' 4'' = 15^{\circ} \\ \text{Q EWN } 3 & \quad 5^{\circ} 14' 9'' = -5^{\circ} \\ \text{Q EWN } 4 & \quad 5^{\circ} 14' 5'' = +10^{\circ} \end{aligned}$$

Q.N=1.8110<sup>6</sup> DEG/FOOT



CH 1 CH 2 CH 3 CH 4  
CH 5 CH 6 CH 7 CH 8  
CH 9 CH 10 CH 11 CH 12  
CH 13 CH 14 CH 15 CH 16  
CH 17 CH 18 CH 19 CH 20  
CH 21 CH 22 CH 23 CH 24  
CH 25 CH 26 CH 27 CH 28  
CH 29 CH 30 CH 31 CH 32  
CH 33 CH 34 CH 35 CH 36  
CH 37 CH 38 CH 39 CH 40  
CH 41 CH 42 CH 43 CH 44  
CH 45 CH 46 CH 47 CH 48  
CH 49 CH 50 CH 51 CH 52  
CH 53 CH 54 CH 55 CH 56  
CH 57 CH 58 CH 59 CH 60  
CH 61 CH 62 CH 63 CH 64  
CH 65 CH 66 CH 67 CH 68  
CH 69 CH 70 CH 71 CH 72  
CH 73 CH 74 CH 75 CH 76  
CH 77 CH 78 CH 79 CH 80  
CH 81 CH 82 CH 83 CH 84  
CH 85 CH 86 CH 87 CH 88  
CH 89 CH 90 CH 91 CH 92  
CH 93 CH 94 CH 95 CH 96  
CH 97 CH 98 CH 99 CH 100

DUM 1 51,2,34 = 0°

DUM 9 51,4 = +5° 52,3 = -5°

DUM 5 51,4 = +10° 52,3 = -10°

DUM 1 51,2,34 = 0° (2A) = 276 X 10<sup>6</sup> PCE FOOT

DUM 9 51,4 = +5° 52,3 = -5°

DUM 5 51,4 = +10° 52,3 = -10°

DEC

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~~TEST 10E 173 TIC 5  
COLLECTOR TANDEM PRESSURE TUNNEL  
LANGLEY RESEARCH CENTER  
WASHED OFF MACH NO: 0.70~~

$\alpha_{\text{crit}} = 3.5^\circ \text{ per foot}$   
 $\delta_{1,2} = 0^\circ$   
 $\delta_{1,3} = +5^\circ$   
 $\delta_{1,4} = +5^\circ$   
 $\delta_{2,3} = -5^\circ$   
 $\delta_{2,4} = -10^\circ$

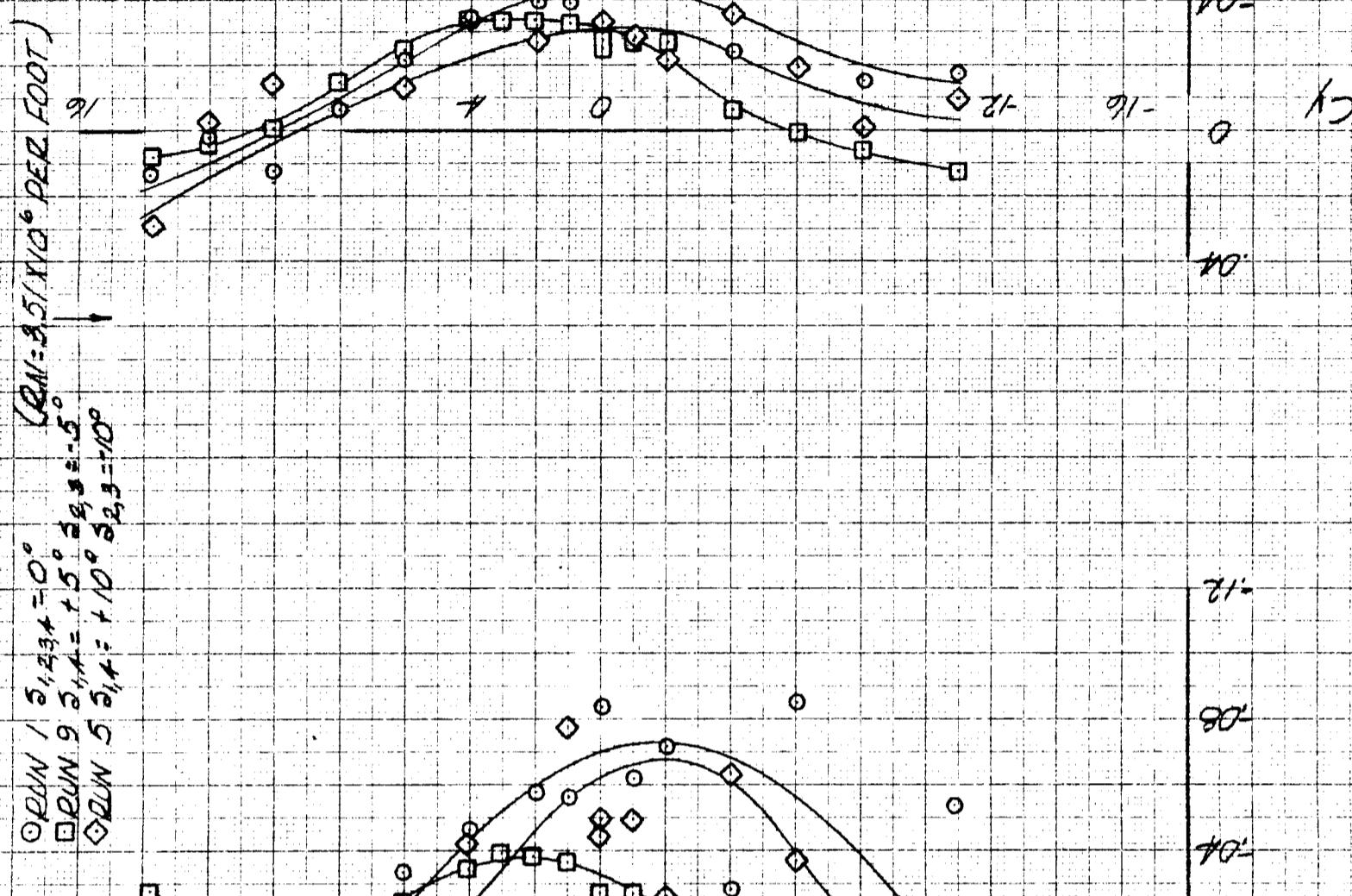
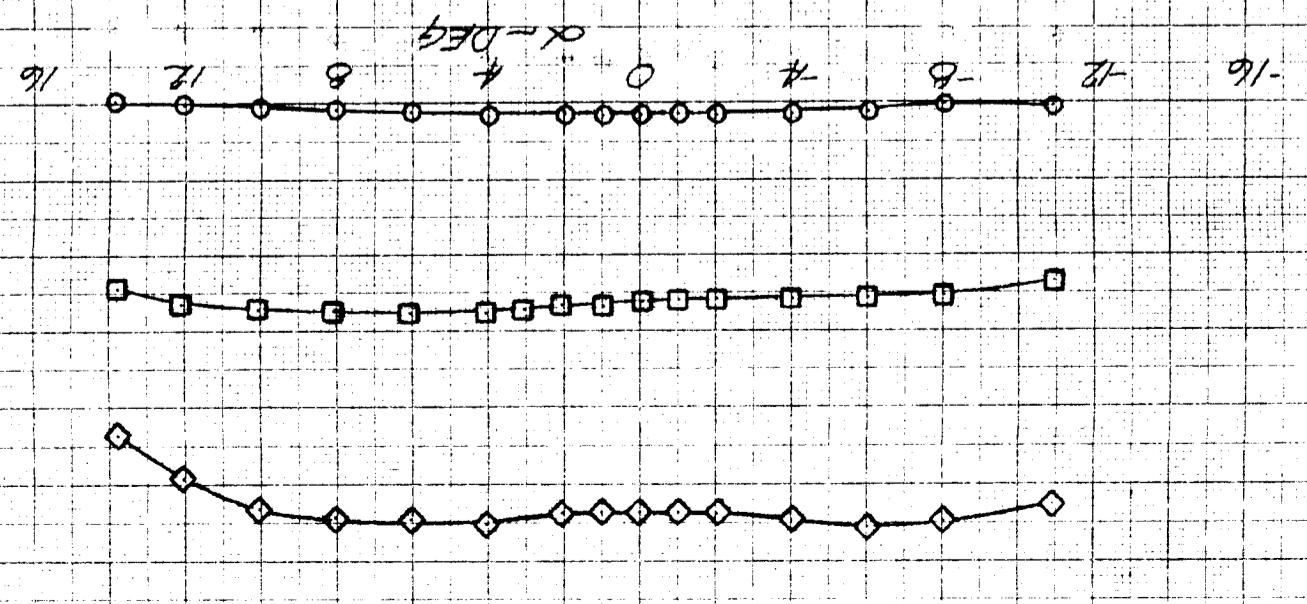
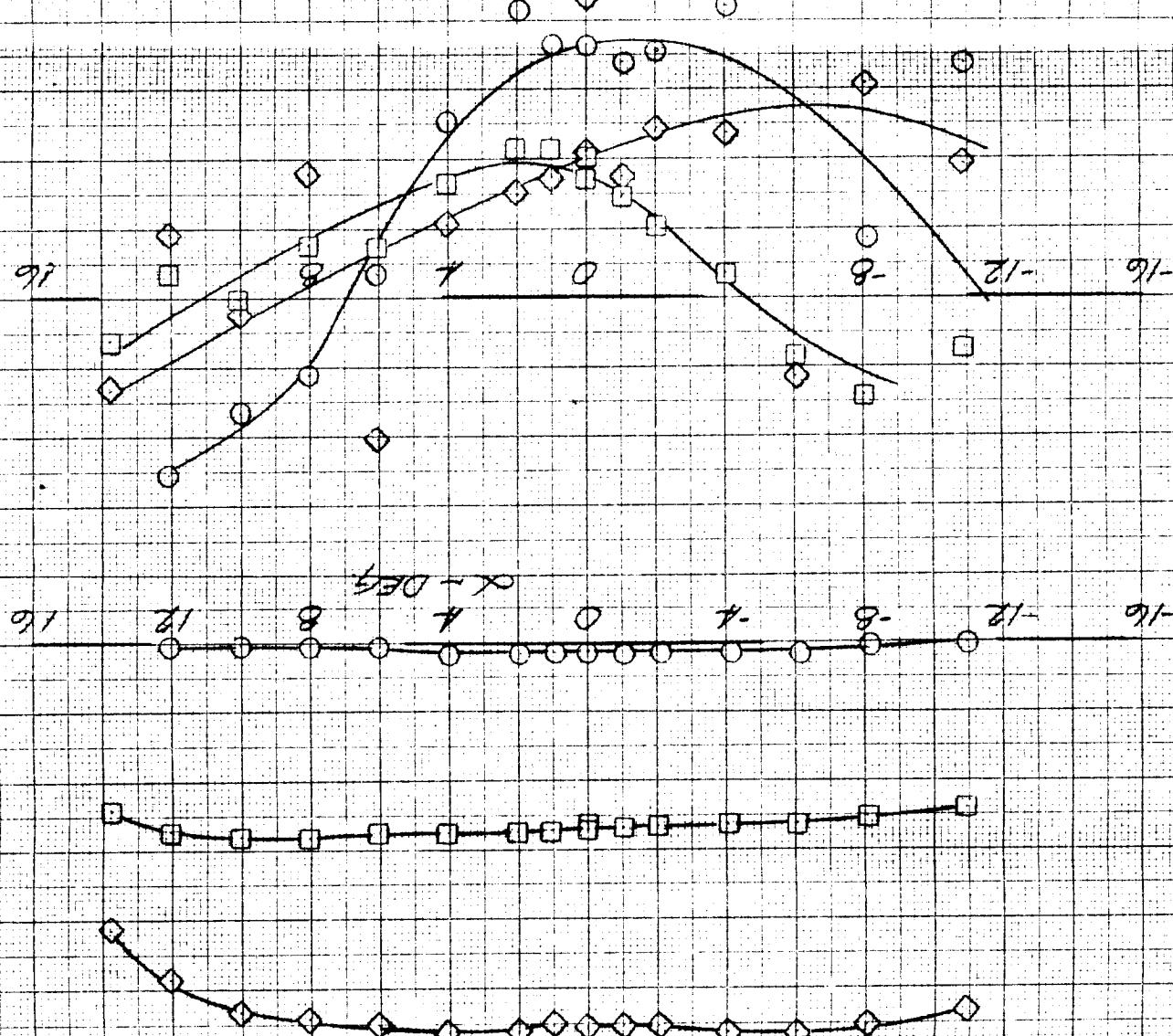


FIGURE 41

ROLL 11421027737C3  
ANGLE 5.4 TRANSONIC DUCT TUNNEL  
WISCONSIN TEST MACH NO. 0.80

OPEN  $\delta_{1,2,3,4} = 0^\circ$   
DWN  $\delta_{1,2,3,4} = 5^\circ$   
DWN  $\delta_{1,2,3,4} = 10^\circ$

( $\theta_N = 37.910^\circ$  DEG FOOT)



ROLL CATCHES / 57/C5  
LANGLEY STATIONIC PRESSURE TUNNEL  
WASHER SIZE MEASURE NO = 0.90

○ RUN 1  $\delta_{1,2,3,4} = 0^\circ$   
 □ RUN 9  $\delta_{1,4} = +5^\circ$   $\delta_{2,3} = -5^\circ$   
 ◇ RUN 5  $\delta_{1,4} = +10^\circ$   $\delta_{2,3} = 10^\circ$

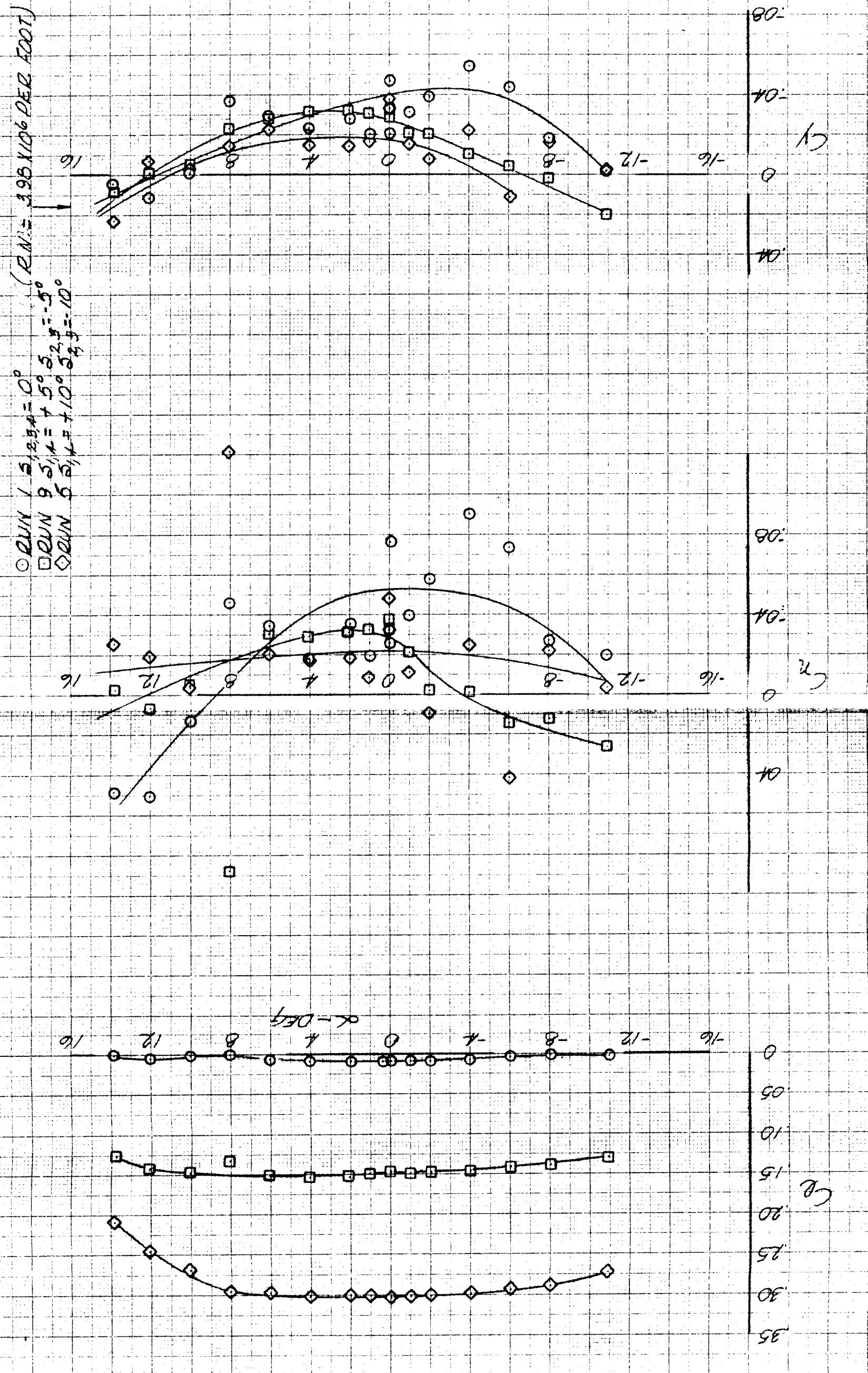


FIGURE 43

LITKE JOKE II  
COLLECTED STICKS  
LANGLEY 50' TRANSONIC PRESSURE TUNNEL  
WASHED 2 SEC MACH 10:0.95

O WIN 1  $51^{\circ} 23' + 0^{\circ}$   
O WIN 9  $51^{\circ} 11' + 5^{\circ} 52' - 5^{\circ}$   
O WIN 5  $51^{\circ} 14' + 10^{\circ} 52' - 10^{\circ}$

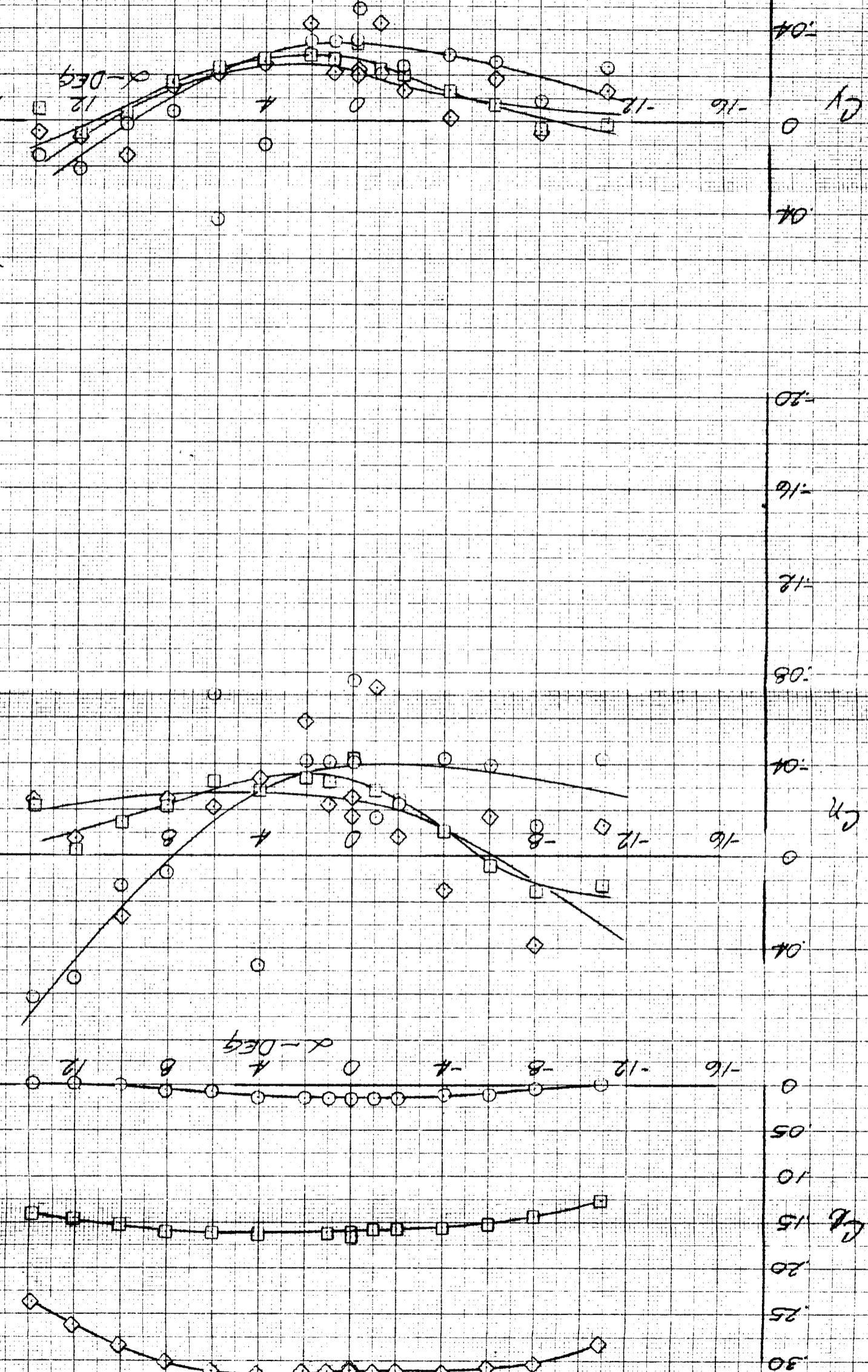


FIGURE 44

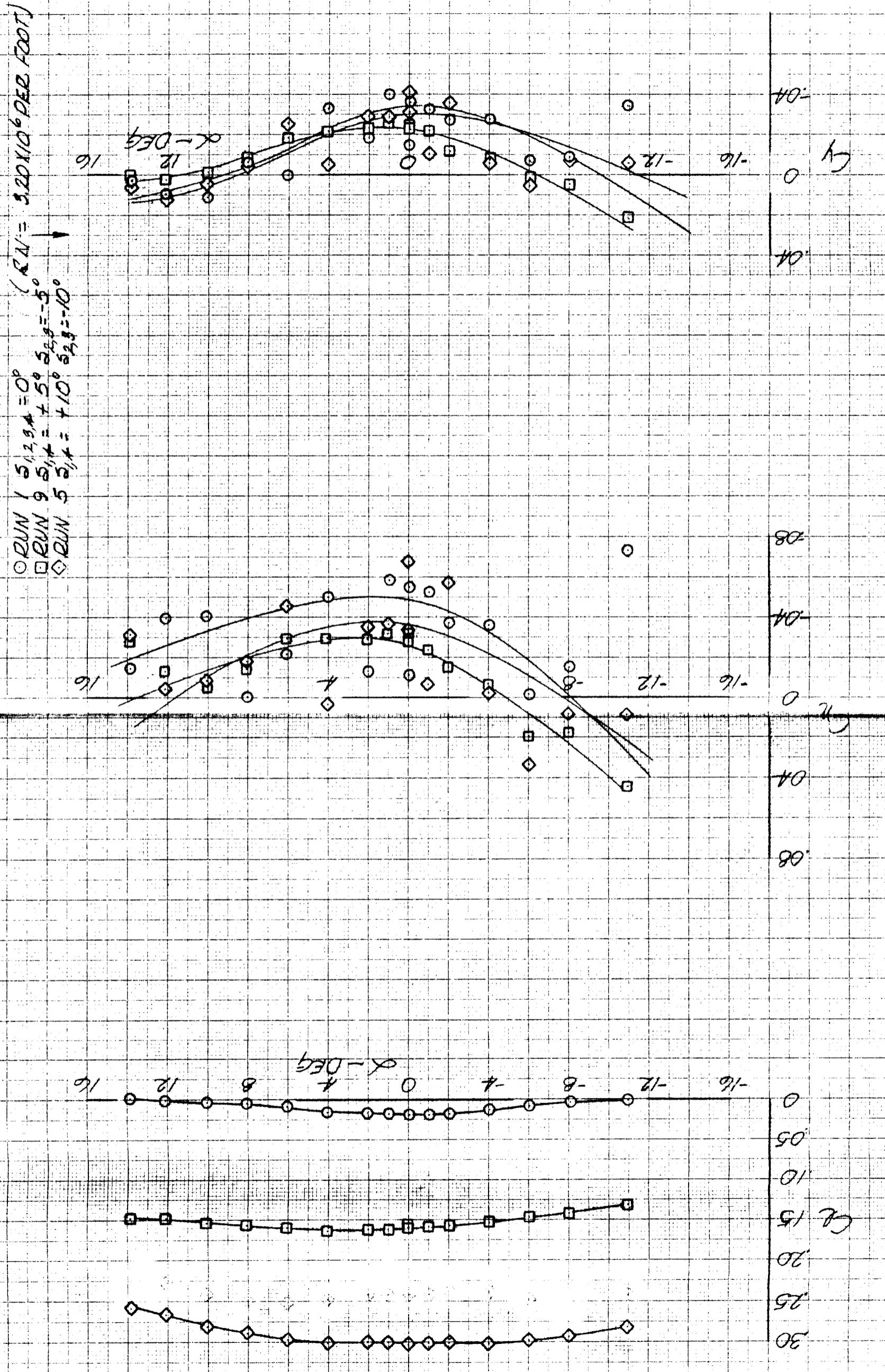


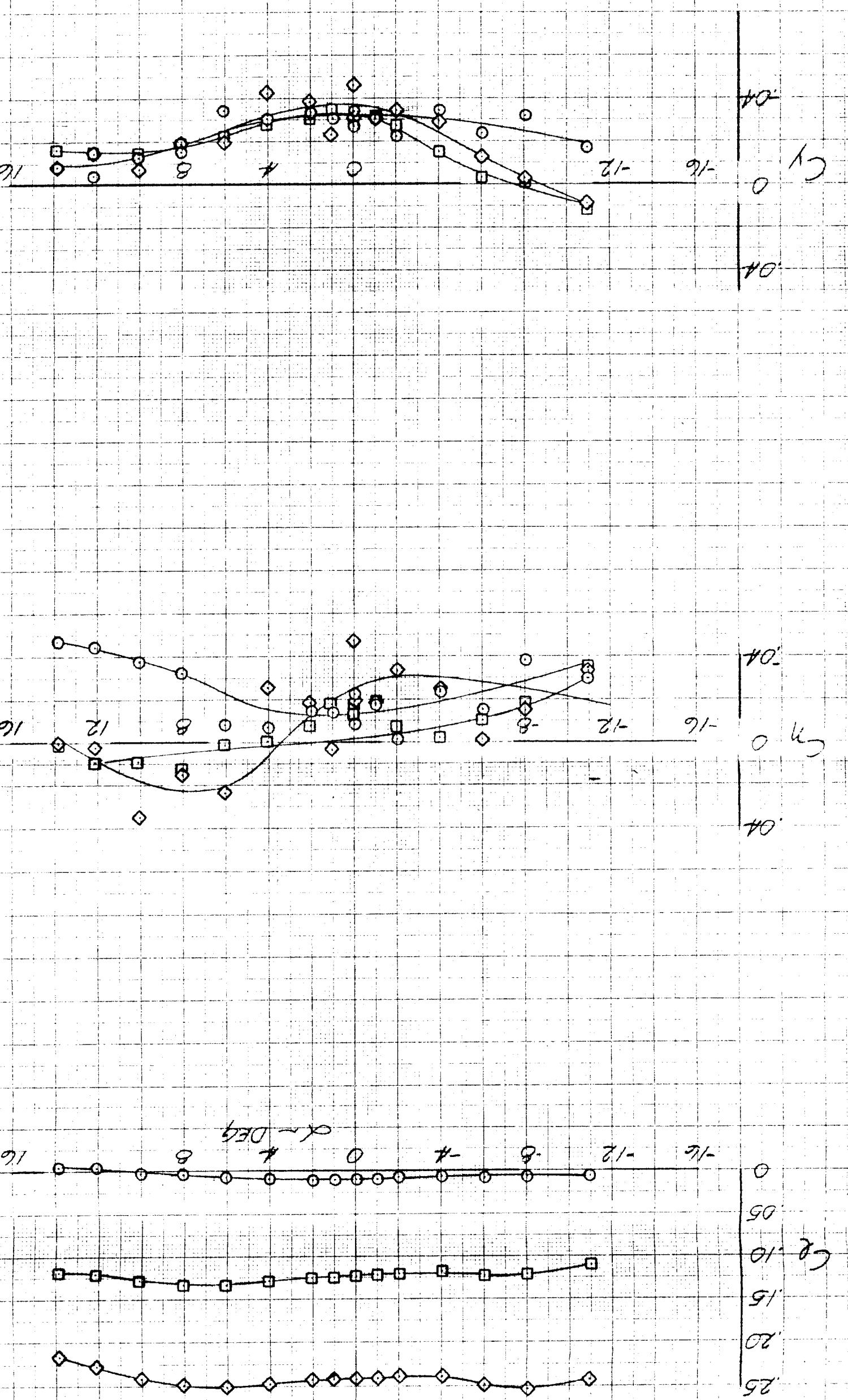
FIGURE 45

GENERAL DYNAMICS CONVAIR

17TH 6 105 01  
ROLL CHASE ACTED 137IC  
LARGE BY TRANSONIC DECAY TUNNEL  
WASHED OFF DEC MARCH NO-120

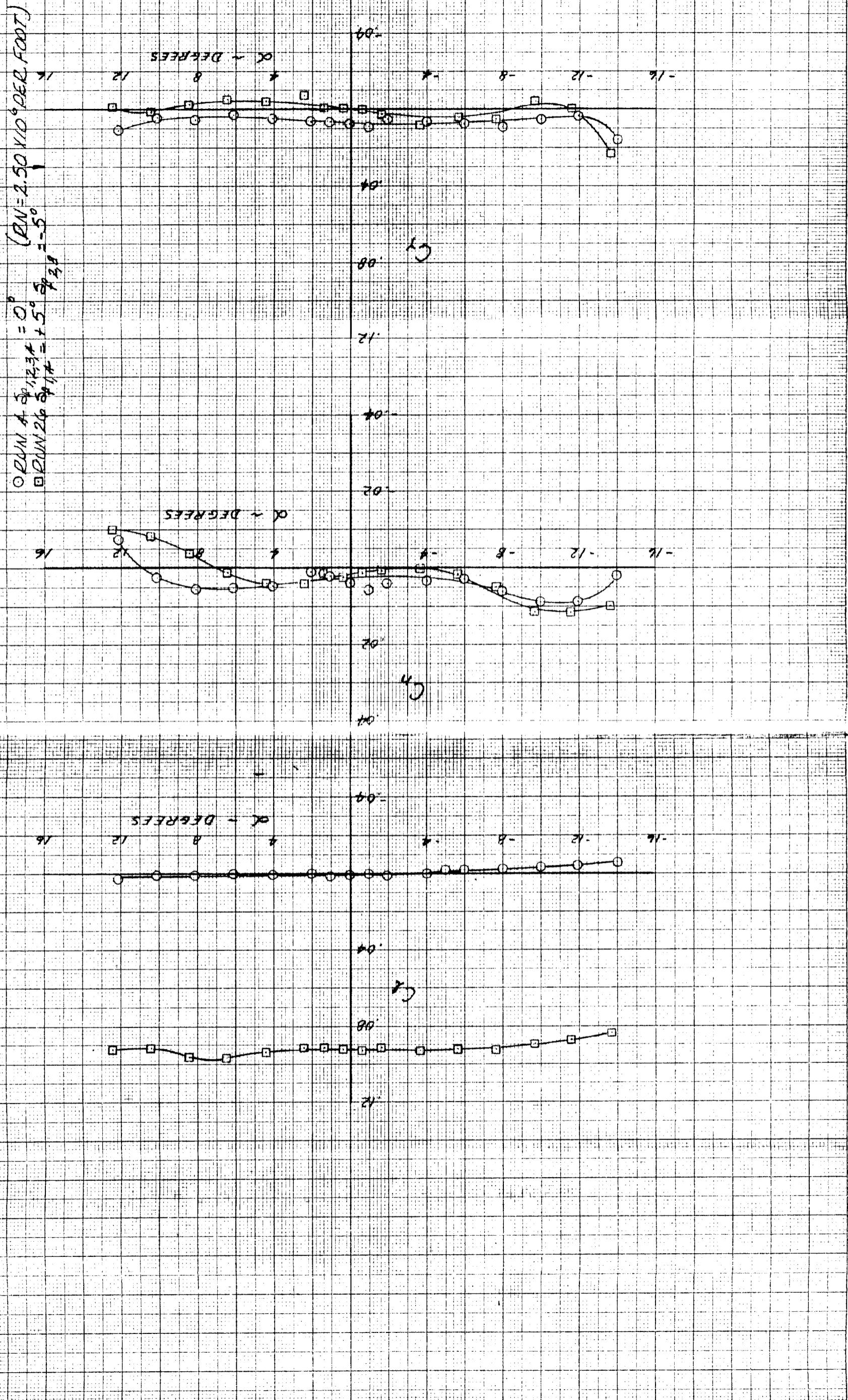
○ RUN 1  $\delta_{12} = 0^\circ$   
□ RUN 2  $\delta_{12} = +5^\circ \delta_2 = -5^\circ$   
◇ RUN 3  $\delta_{12} = +10^\circ \delta_2 = -10^\circ$

6211 =  $3.28 \times 10^6$  PER FOOT



PIGUE 46

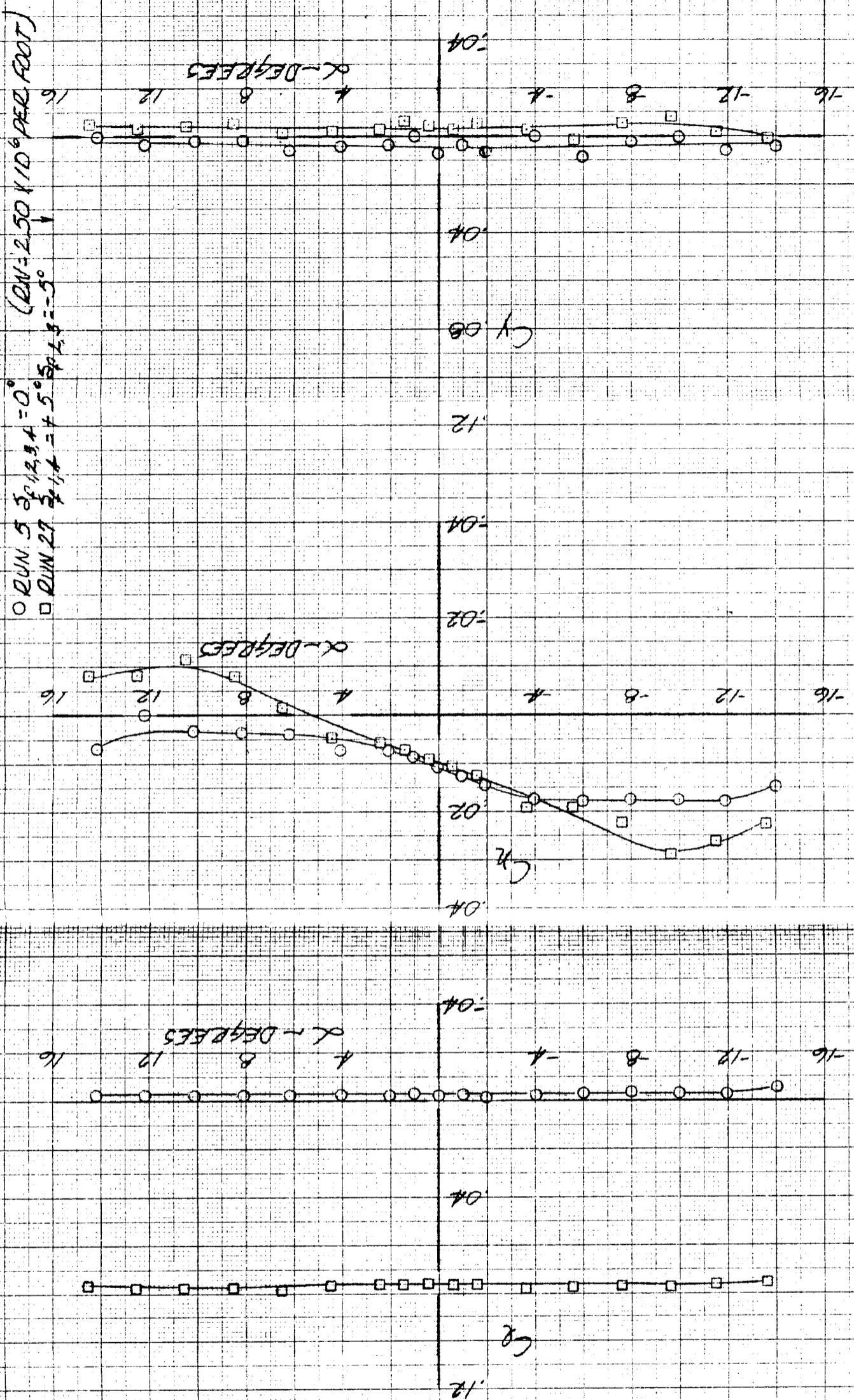
GENERAL DYNAMICS CONVAIR  
44-7057  
POLY CHRACTIC STC 5  
LONGLEY LANE DRONE TEST TUNNEL  
MANUFACTURE NO: 157



GENERAL DYNAMICS CONVAIR

Model 12 Date 19 February 1963

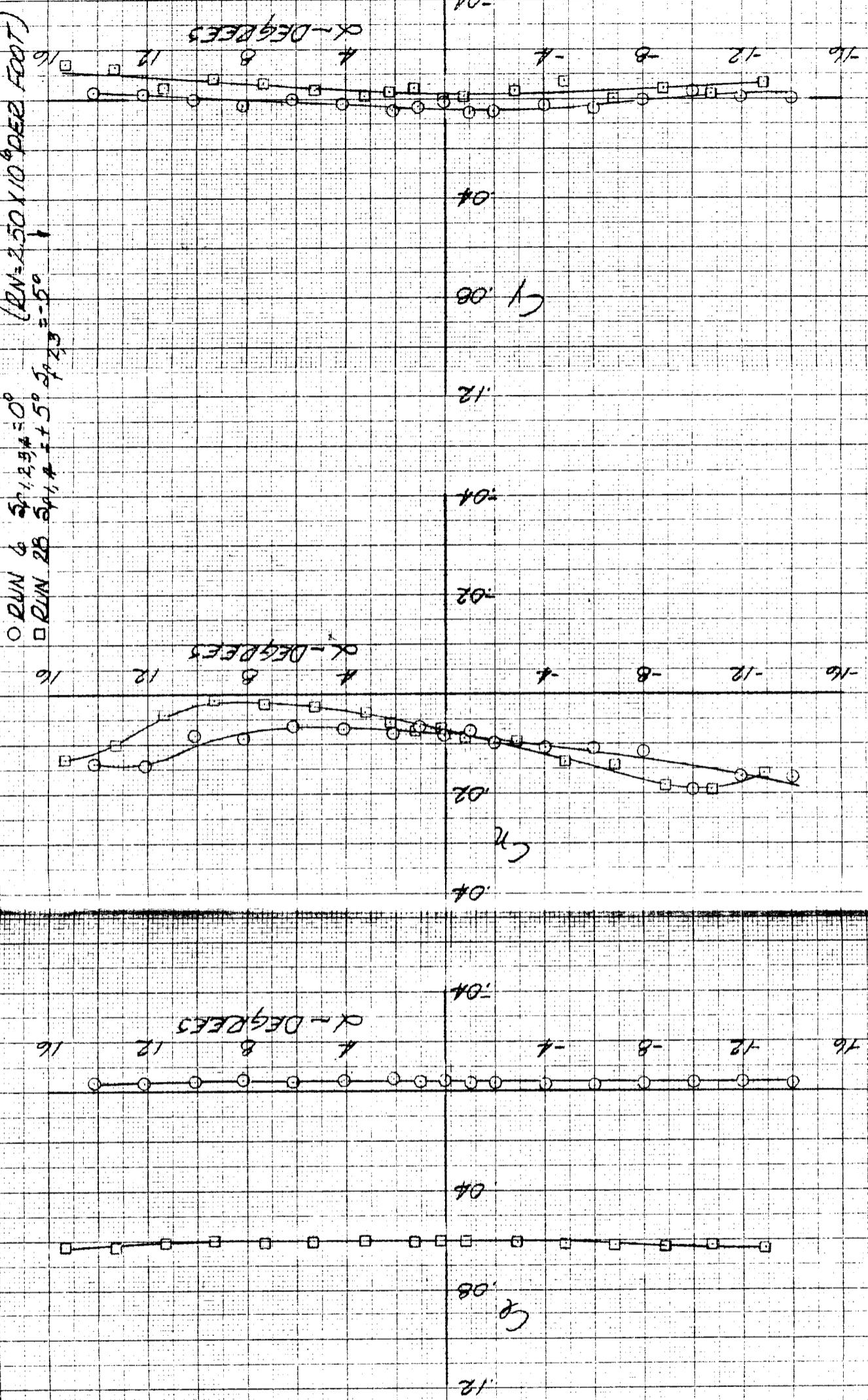
FIGURE 47



GENERAL DYNAMICS CONVAIR

Model 12 Date 19 February 1963

### FIGURE 4B



COLL 5 10 ACT 2 E 15 TCS  
LANGLEY UNIT 2 PLAN 51000 SONIC TUNNEL  
MACH 10 = 2.16

$\alpha - \text{DEGREES}$	$\beta - \text{DEGREES} (\text{RWN } 6)$	$\beta - \text{DEGREES} (\text{RWN } 2B)$	$\beta - \text{DEGREES} (\text{RWN } 1/2, 3/4, 5/6, 7/8)$
4	10.0	10.0	10.0
6	11.0	11.0	11.0
8	12.0	12.0	12.0
10	13.0	13.0	13.0
12	14.0	14.0	14.0
14	15.0	15.0	15.0
16	16.0	16.0	16.0

A graph on grid paper showing two horizontal lines. The top line has six open circles connected by a horizontal line. The bottom line has five open squares connected by a horizontal line. The lines are positioned such that they are parallel to each other.

The figure consists of three vertically stacked line graphs sharing a common x-axis representing time from 70' to 76'. Each graph has four horizontal grid lines representing different levels.

- Top Graph:** Shows data series A (open circles), B (open squares), and C (open triangles). All series show a slight upward trend over time.
- Middle Graph:** Shows data series A (open circles), B (open squares), and C (open triangles). All series show a downward trend over time.
- Bottom Graph:** Shows data series A (open circles), B (open squares), and C (open triangles). All series show a flat trend over time.

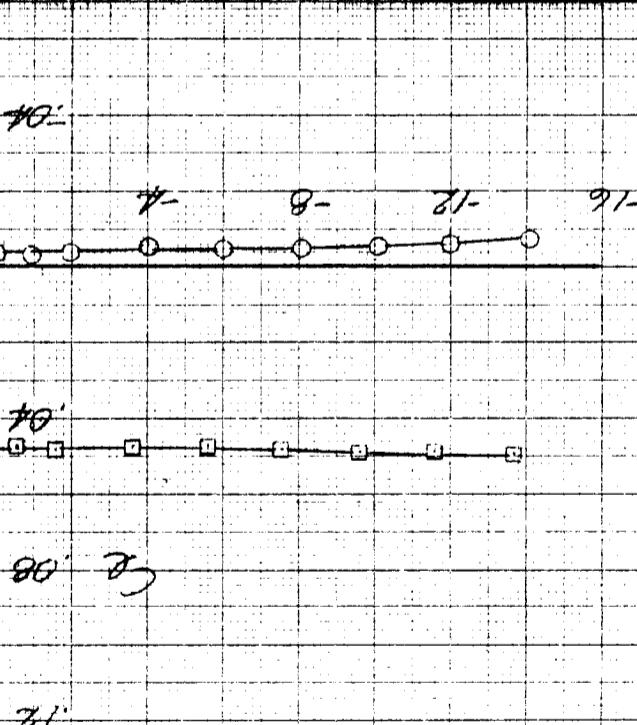
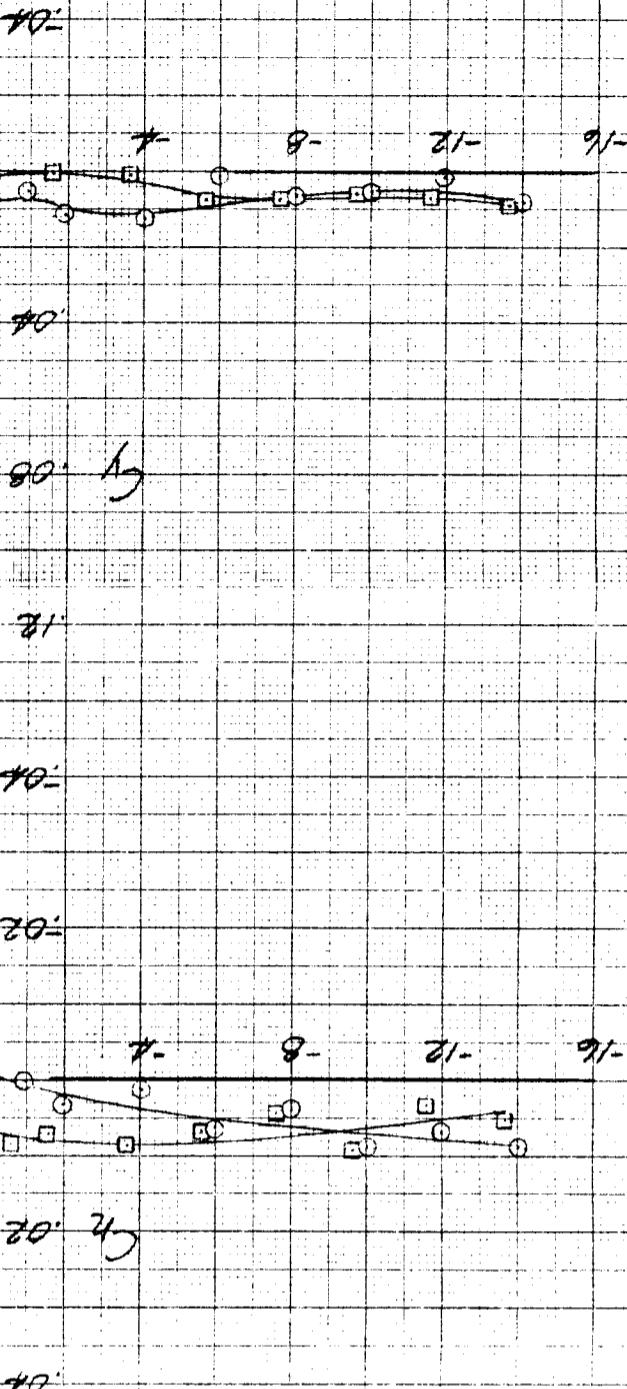
FIGURE 42

0200 7 50°, 2.3°, +0°  
0200 25 50°, 2.3°, -5°

(2H=2.50 X 10<sup>6</sup> DEC FOOT)

R - DEGREES

L11 C11 FACTEC 157C5  
DOOLLEY UNITED PLAN 5000' 30'IC TUNNEL  
LAWATHER 0 AT MACH 1.0:2.00



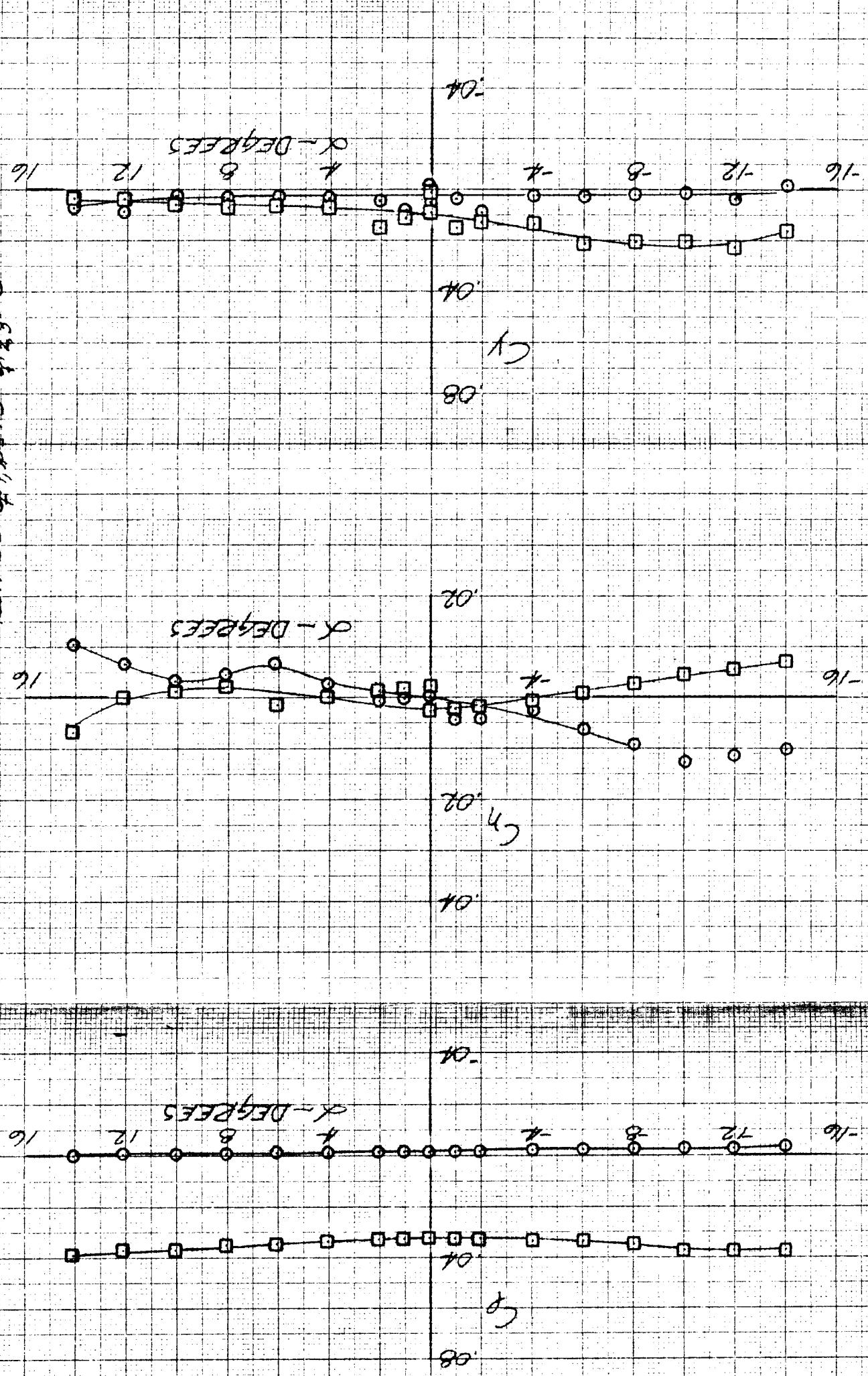
Model 12  
Date 19 February 1963

GENERAL DYNAMICS CONVAIR

11715-102-11715  
POLYCARBONATE PLATE  
LANGLEY MAJHEC 025 MACH NO: 3.86

RUN 29  $\alpha = 0^\circ$   
RUN 39  $\alpha = -5^\circ$

( $\Delta \alpha = 2.50 \times 10^{-6}$  DEG FOT)



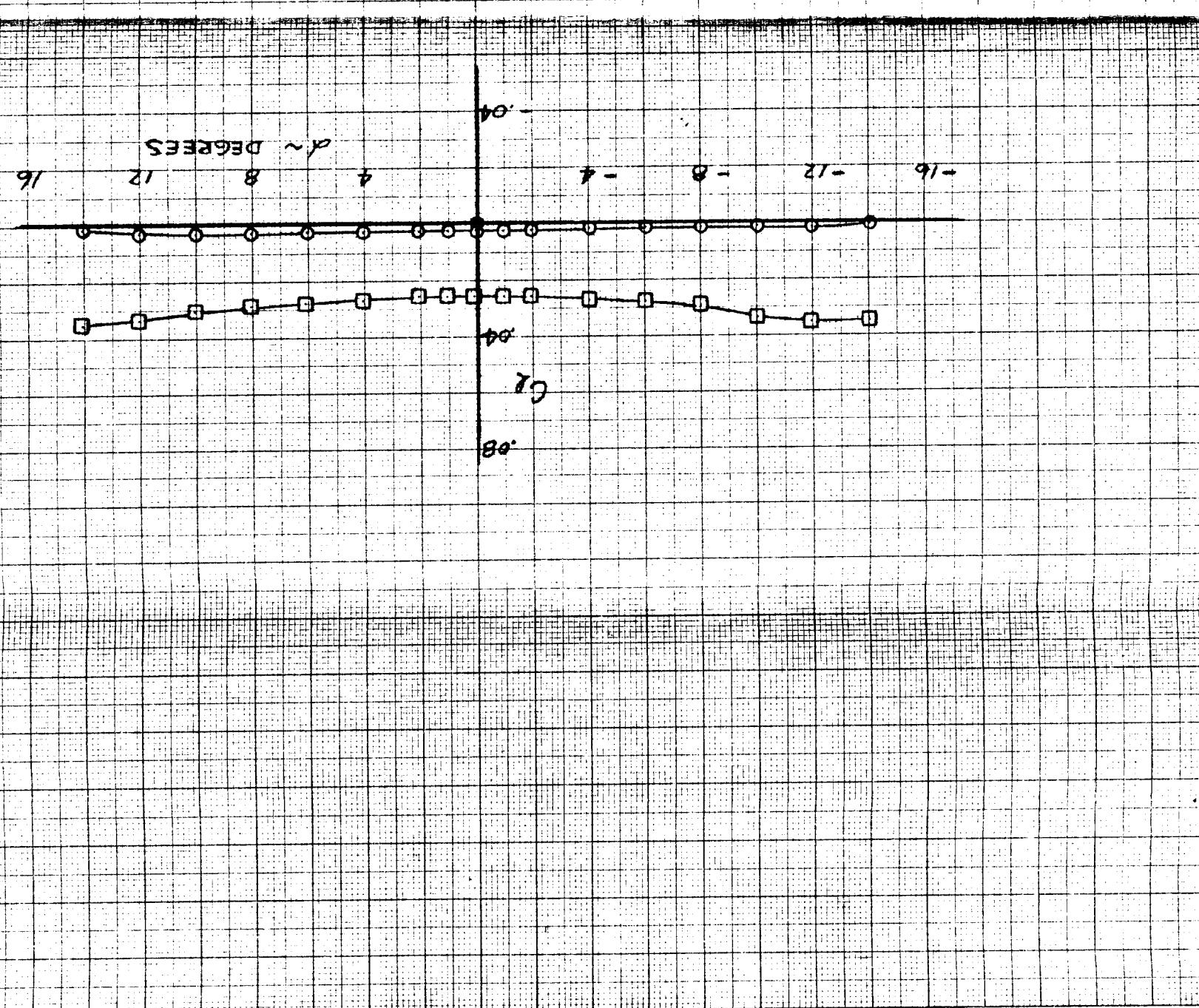
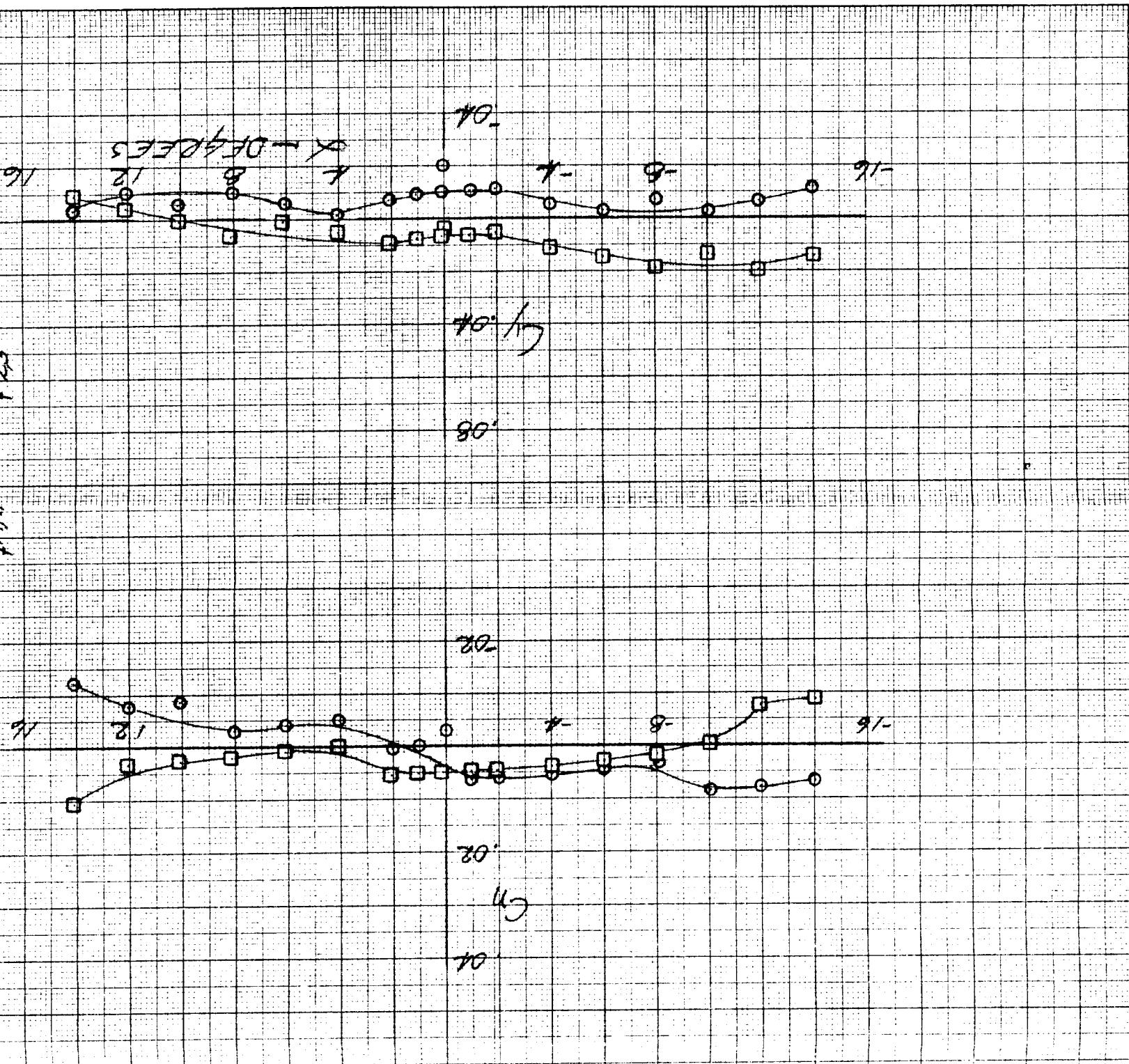
GENERAL DYNAMICS CONVAIR

Model Data 12 19 February 1963

~~CHARGE LINE 12V 10A 12V 10A 12V 10A 12V 10A~~

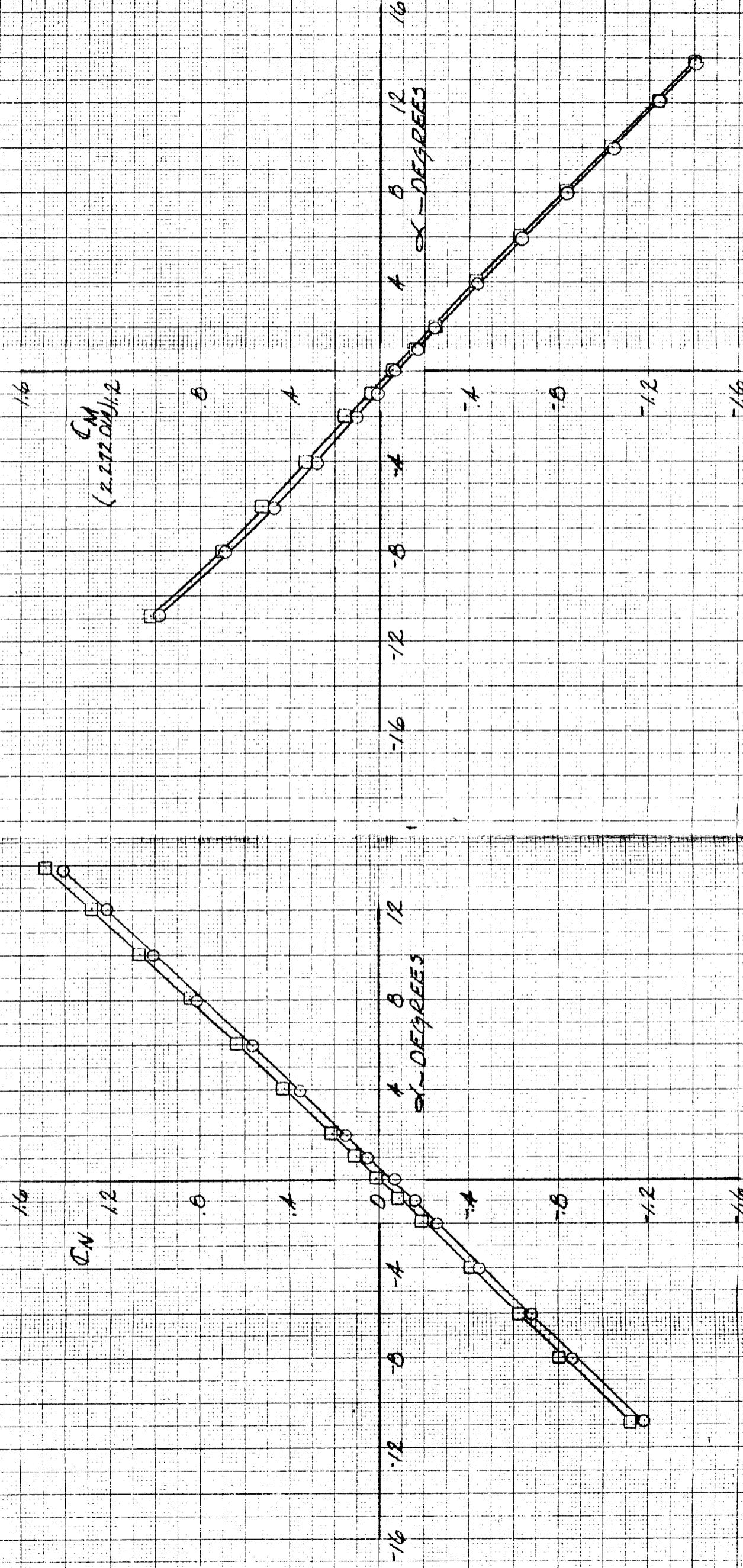
0 min 30° 30° = 0° (Min. 2.50 x 10<sup>6</sup> Foot)

卷之三



EFFECT OF WASHERS ON LONGITUDINAL CHARACTERISTICS  
CHANGED SET TRANSVERSE PRESSURE TUNNEL  
 $MACH_{10} = 0.20$

O RUN 1 WASHER OFF  $57/33\# = 0^\circ$   
□ RUN 2 WASHER ON  $57/33\#$   
(CN = 1.800 PER FOOT)



Model 12  
19 February 1963

# LITTLE JOE II

Page 63  
Report No. 63-426  
Figure 58

EFFECT OF WASHER ON  
LONGITUDINAL CHARACTERISTICS  
LANGLEY 8FT TRANSonic PRESSURE TUNNEL  
MACH NO = 0.30

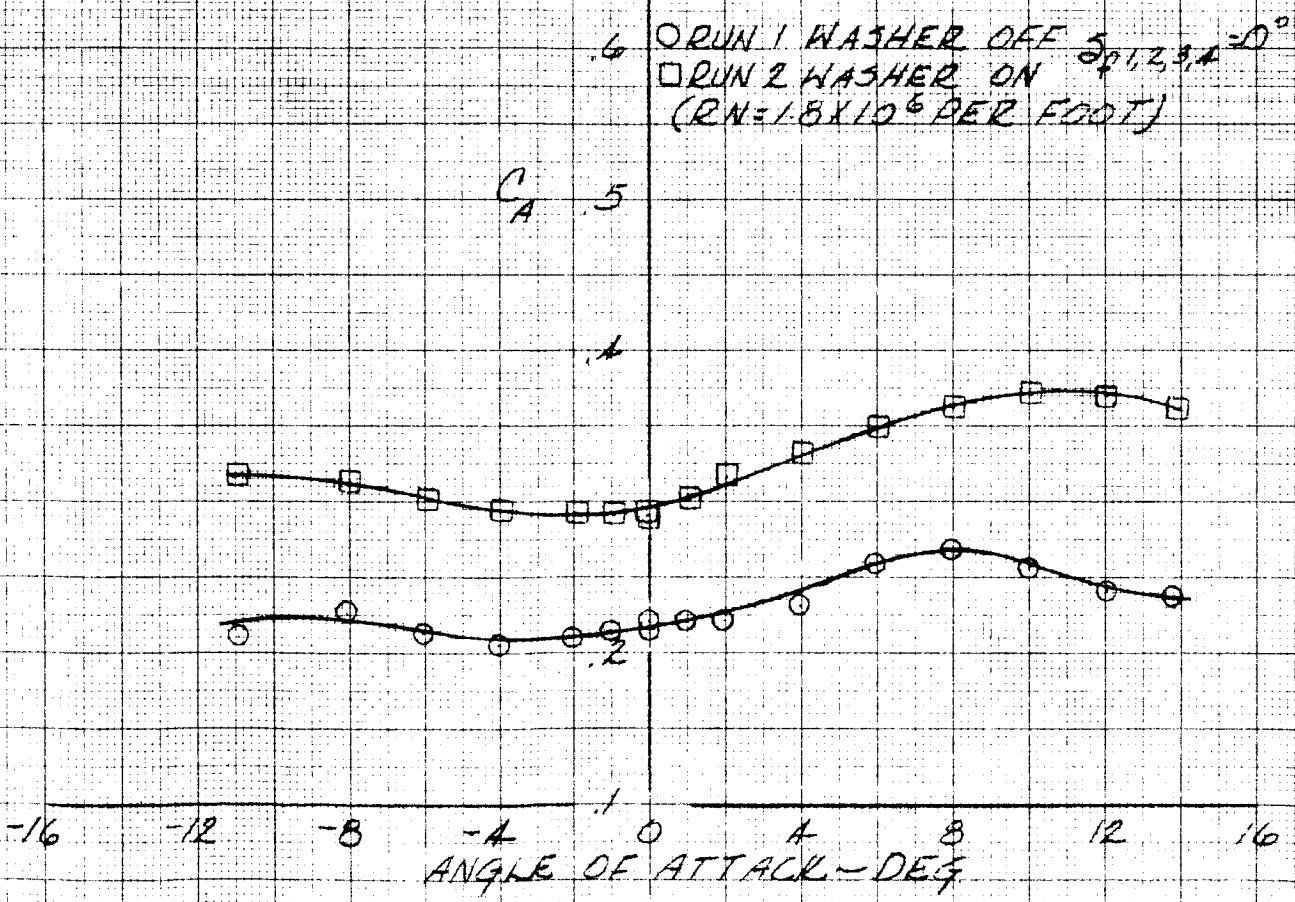
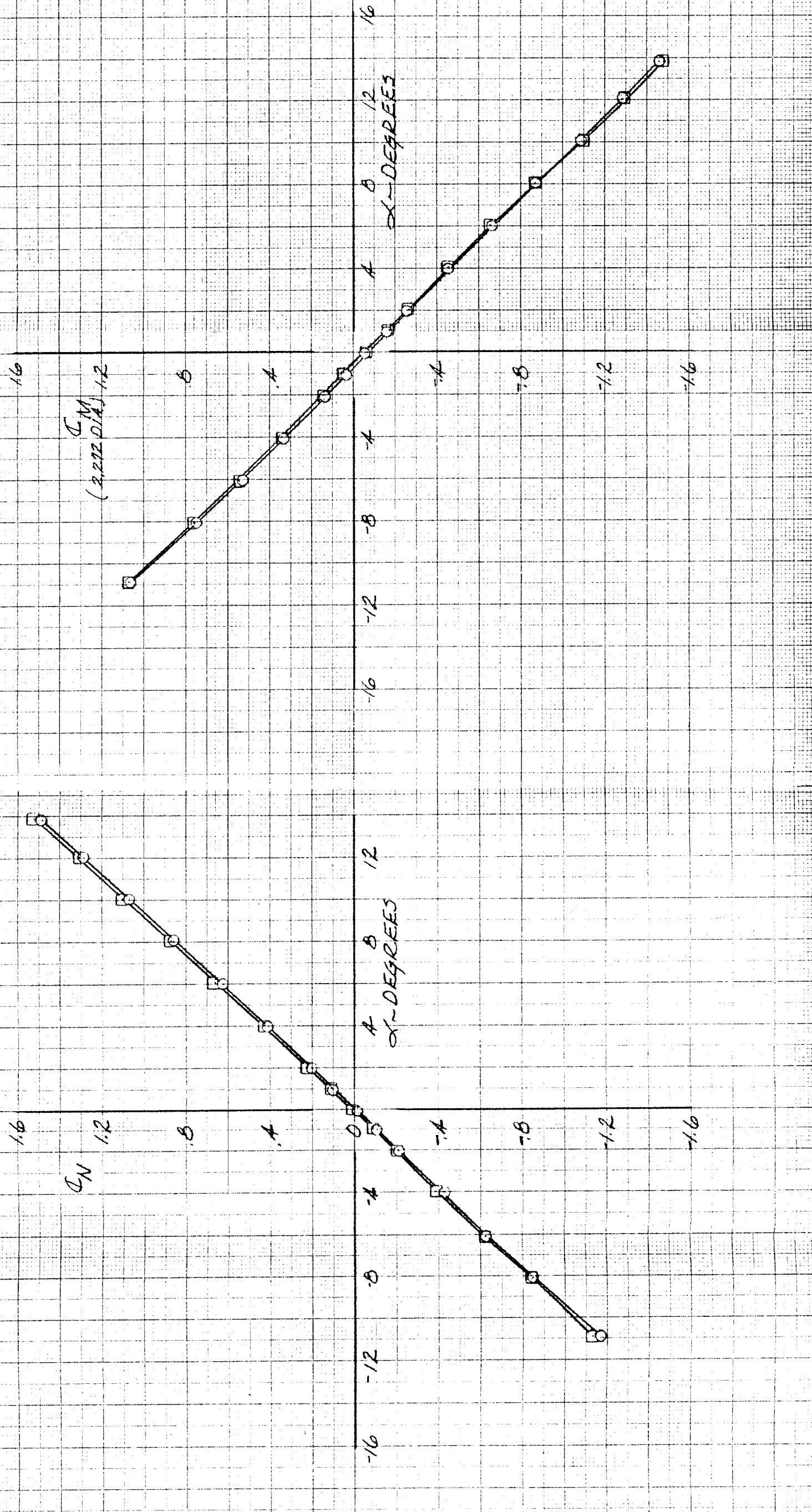


FIGURE 24

LITTLE JOE II  
EFFECT OF WASHER ON LONGITUDINAL CHARACTERISTICS  
ANGLESET TANDEM PRESSURE TUNNEL  
MACH NO = 0.50

○ RUN 1 WASHER OFF    59.1252 = 0°  
□ RUN 2 WASHER ON    (2.222 DIA) 1/2  
(CN = 2.76 X 10<sup>6</sup> PER FOOT)

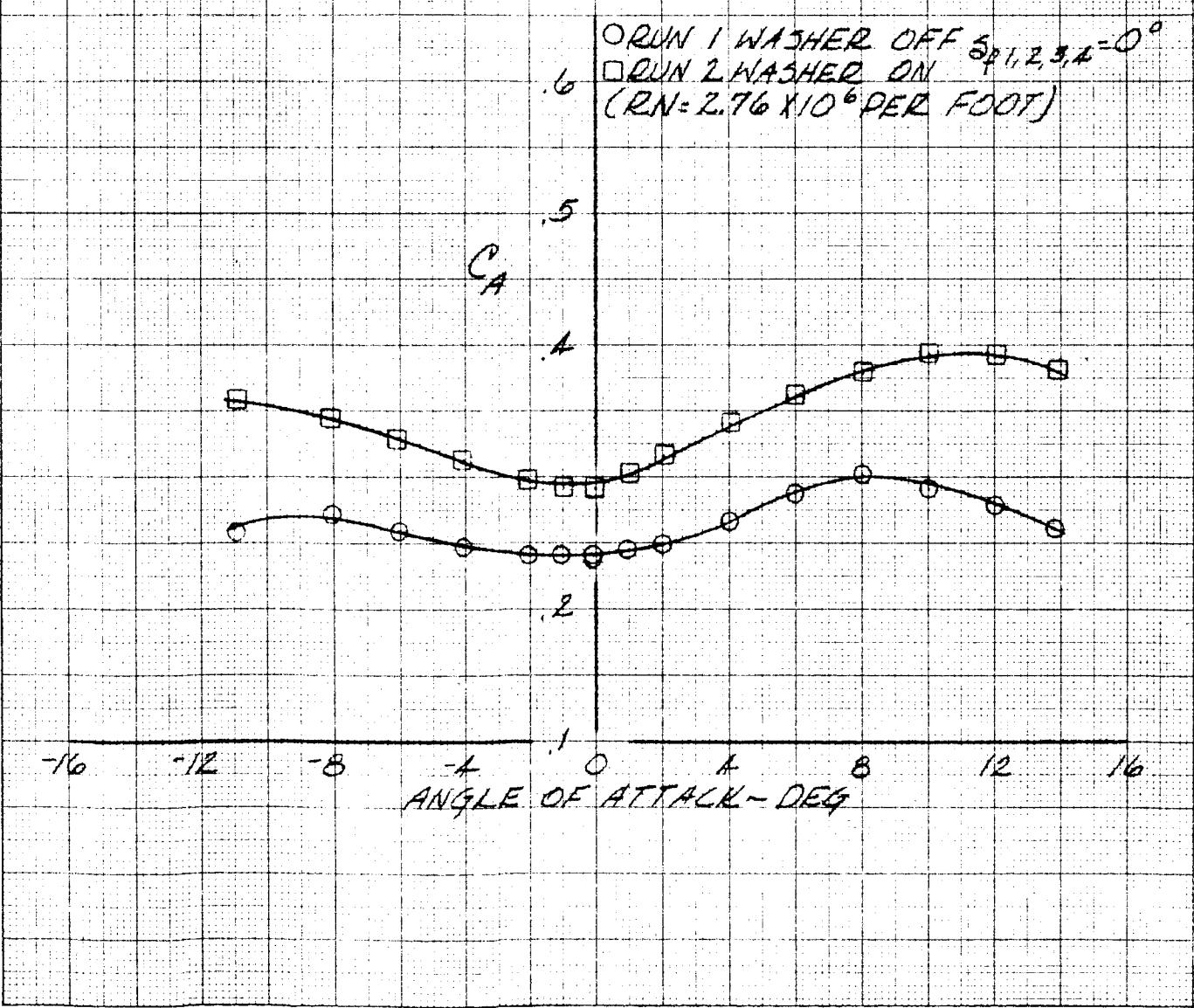


Model 12  
19 February 1963

# LITTLE JOE II

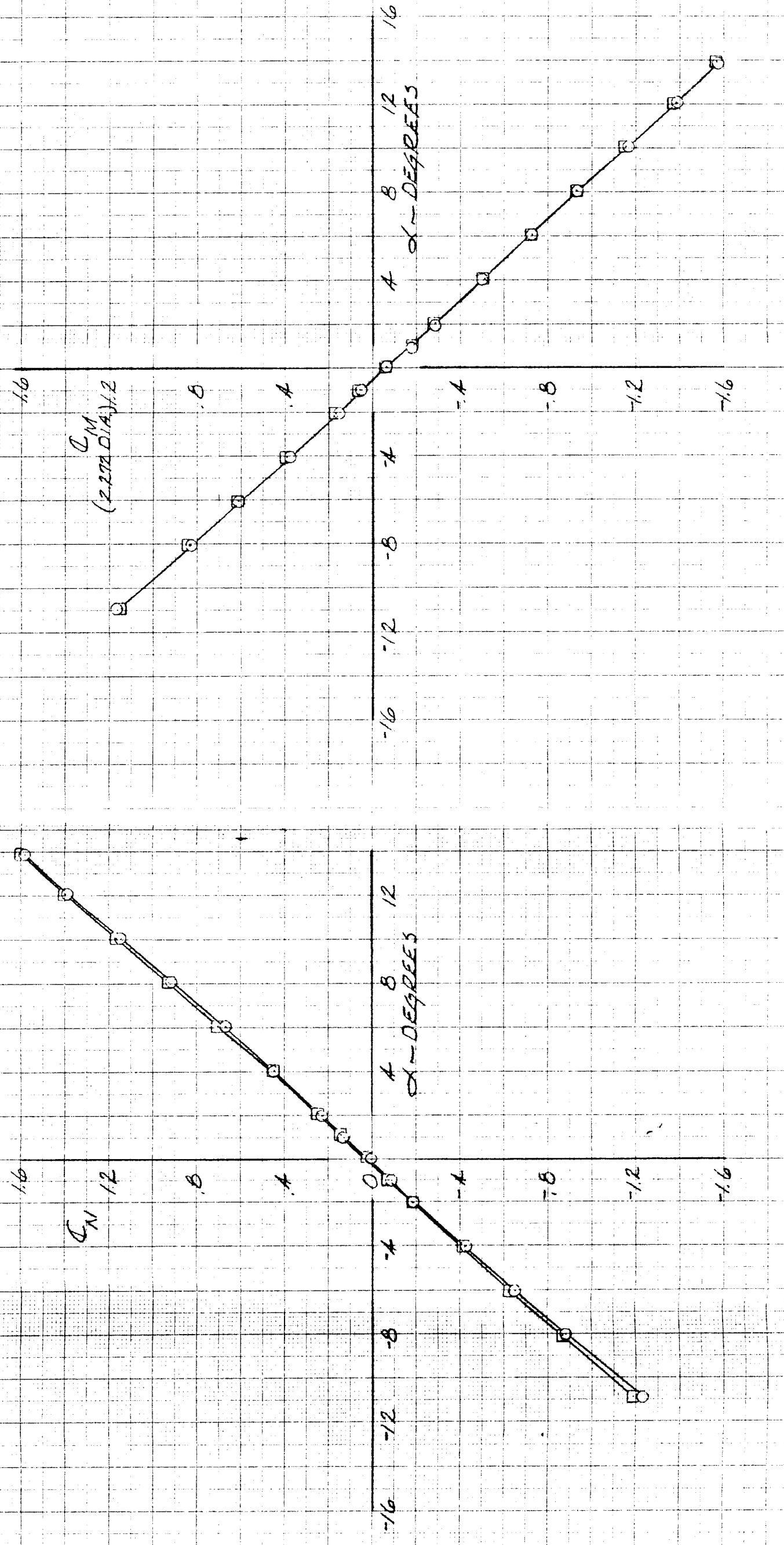
Page 65  
Report No. GDC-63-025  
Figure 55

EFFECT OF WASHER ON  
LONGITUDINAL CHARACTERISTICS  
LANGLEY 8FT TRANSONIC PRESSURE TUNNEL  
MACH NO=0.50



LITTLE JOE II  
EFFECT OF WASHER ON LONGITUDINAL CHARACTERISTICS  
ANGLE SET TRANSVERSE PRESSURE TUNNEL  
LATCH NO -0.70

○ RUN 1 WASHER OFF  $\Delta p_{1,2,3,4} = 0^\circ$   
□ RUN 2 WASHER ON  
( $\Delta p = 3.5 \times 10^6$  PER FOOT)



Model 12  
19 February 1963

LITTLE JOE II

Page 67  
Report No. GDC-63-02  
Figure 57

EFFECT OF WASHER ON  
LONGITUDINAL CHARACTERISTICS  
LANGLEY 8 FT. TRANSONIC PRESSURE TUNNEL  
MACH NO = 0.70

ORUN 1 WASHER OFF SP. 1, 2, 3, 4 = 0°  
ORUN 2 WASHER ON  
(RN =  $3.51 \times 10^6$  PER FOOT)

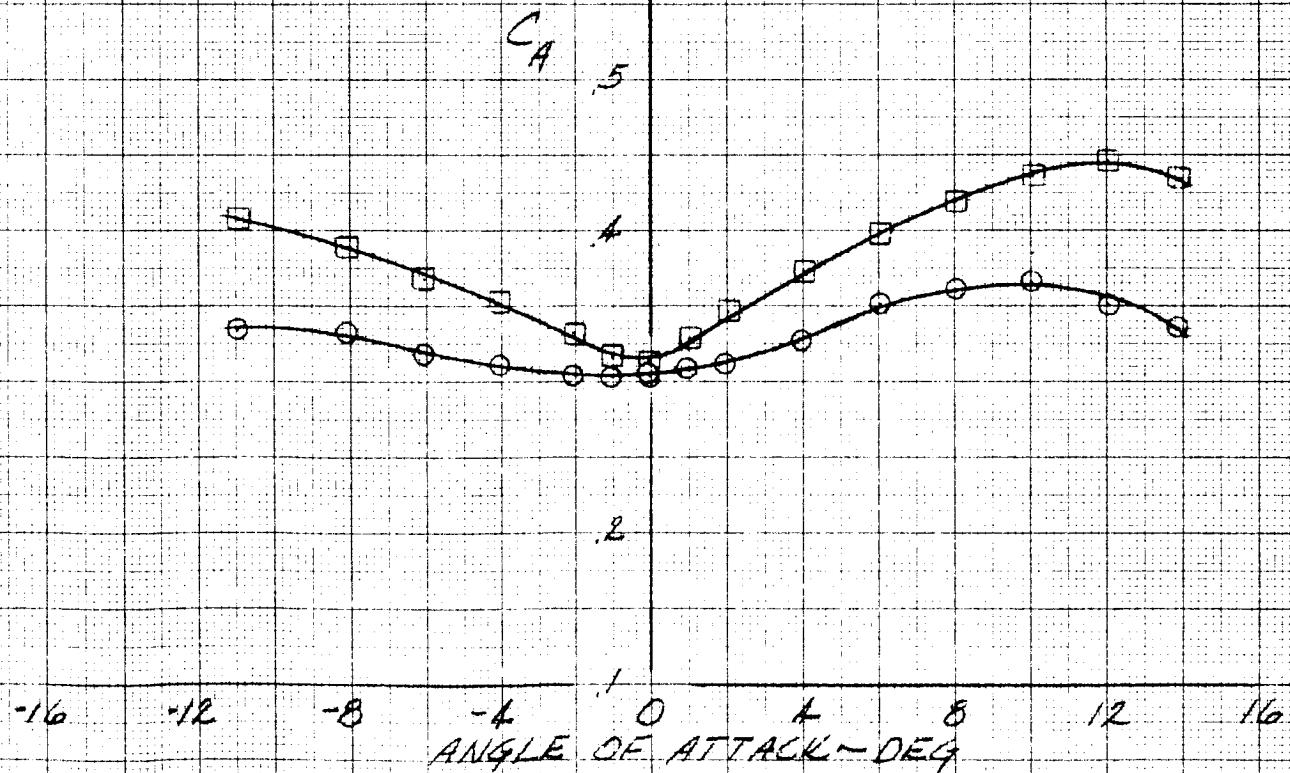
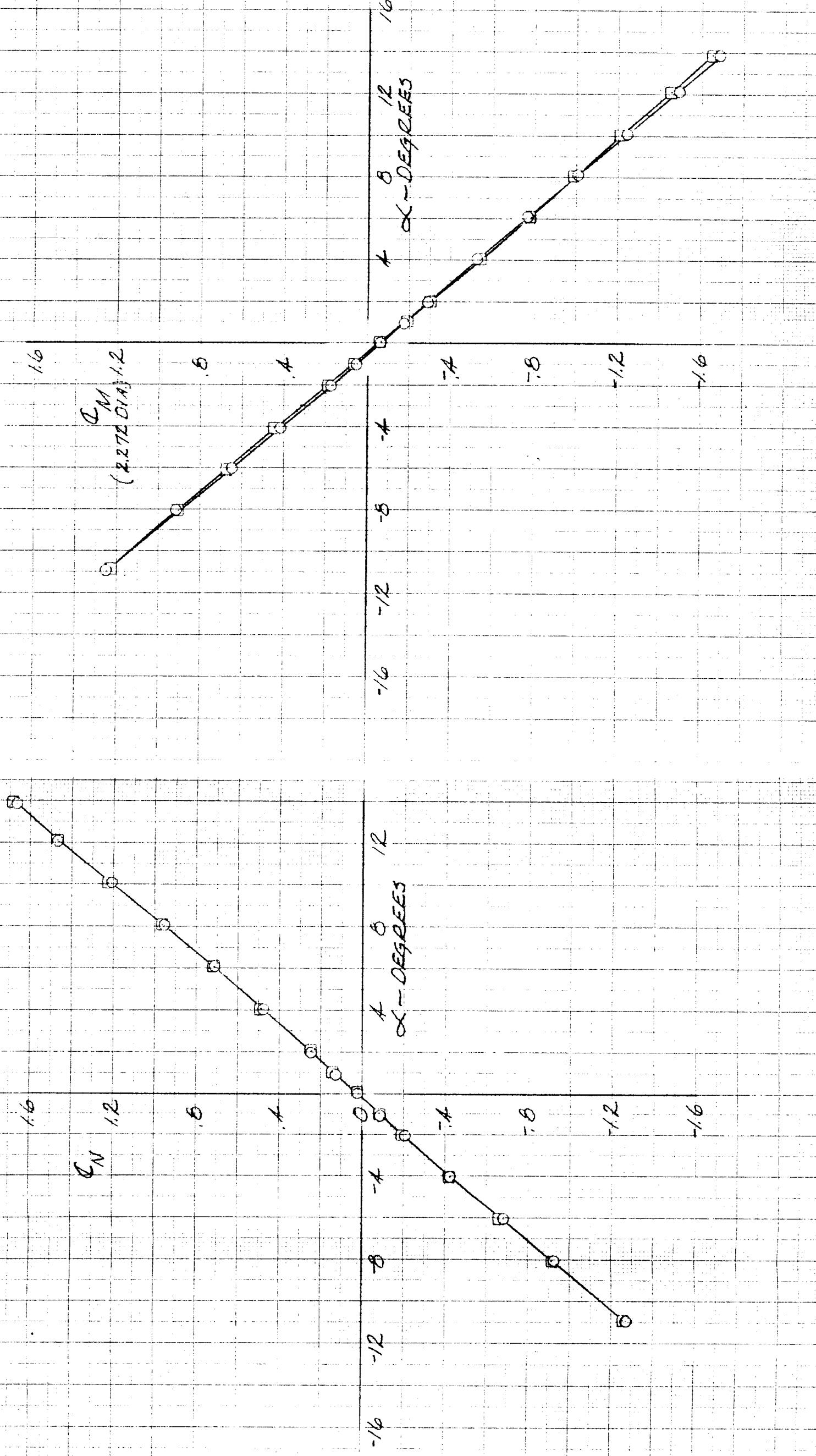


FIGURE 58

LITTELE WASHERS ON LONGITUDINAL CHARACTERISTICS  
EFFECT OF WASHERS ON TRANSONIC PRESSURE TUNNEL  
MACH NO = 0.80

CURVE 1 WASHER OFF SP 1232 = 0°  
CURVE 2 WASHER ON CEN = 3.17 X 10<sup>-6</sup> PER FOOT



Model 12  
19 February 1963

LITTLE JOE II

Page 69  
Report No. GDC-63-025  
Figure 59

EFFECT OF WASHER ON  
LONGITUDINAL CHARACTERISTICS  
LANGLEY 8FT. TRANSONIC PRESSURE TUNNEL  
MACH NO=0.80

○ RUN 1 WASHER OFF  $51,2,3,4 = 0^\circ$   
□ RUN 2 WASHER ON  $(RN = 3.77 \times 10^6 \text{ PER FOOT})$

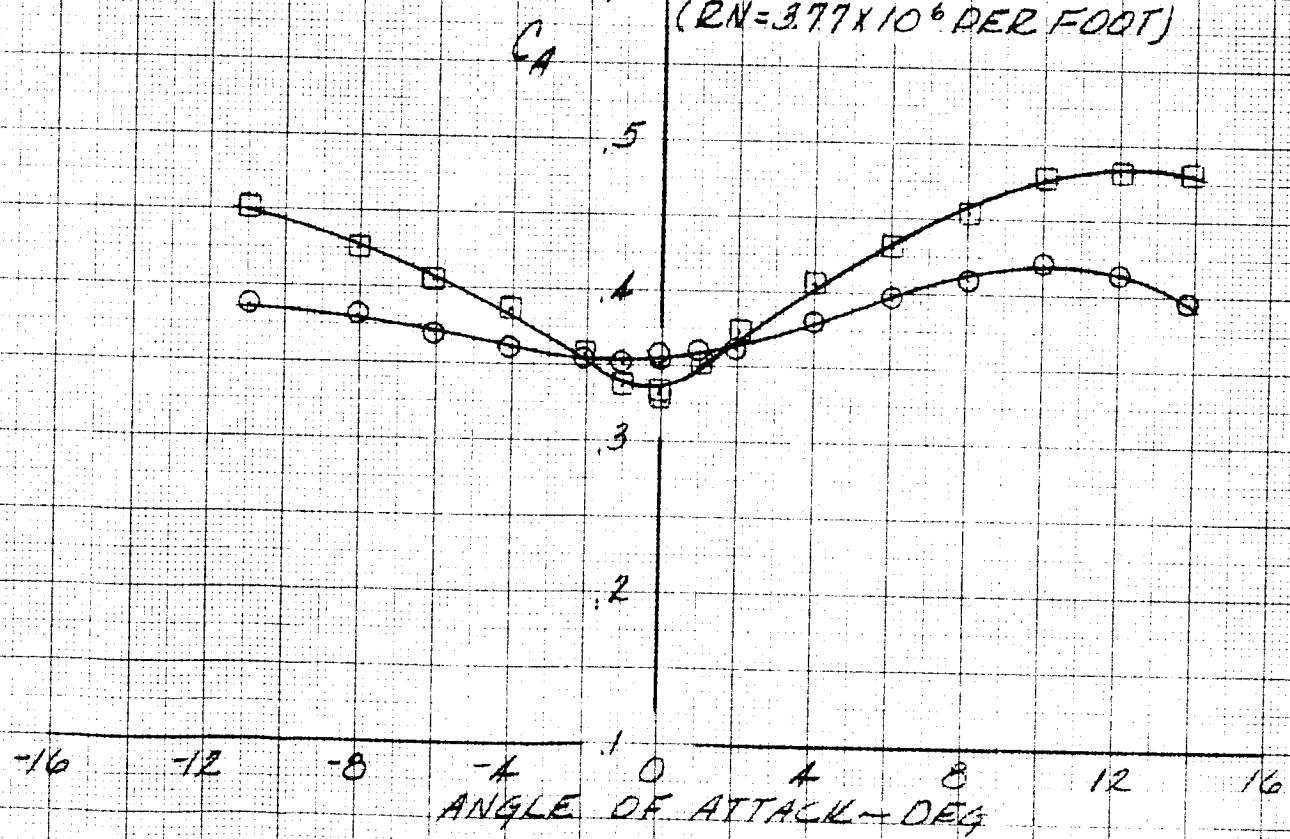


FIGURE 60

EFFECT OF WASHER ON LONGITUDINAL CHARACTERISTICS  
ANGLE 8 FT TRANSONIC PRESSURE TUNNEL  
MACH NO. 0.90

○ RUN 1 WASHER OFF  
□ RUN 2 WASHER ON  
 $R_N = 3.28 \text{ X } 10^6 \text{ PER FOOT}$

$\delta_{PR,34} = 0^\circ$

1.6

$C_M$   
( $2.272 \text{ DIA. } 1.2$ )

0

-4

-8

-12

-16

1.6

+ 8 DEGREES

- 8 DEGREES

12

-4

-12

-8

0

-4

-8

-12

-16

1.6

$C_M$   
1.2

0

-4

-8

-12

-16

1.6

+ 8 DEGREES

- 8 DEGREES

12

-4

-8

-12

-16

-12

-8

-4

0

-4

-12

-8

-4

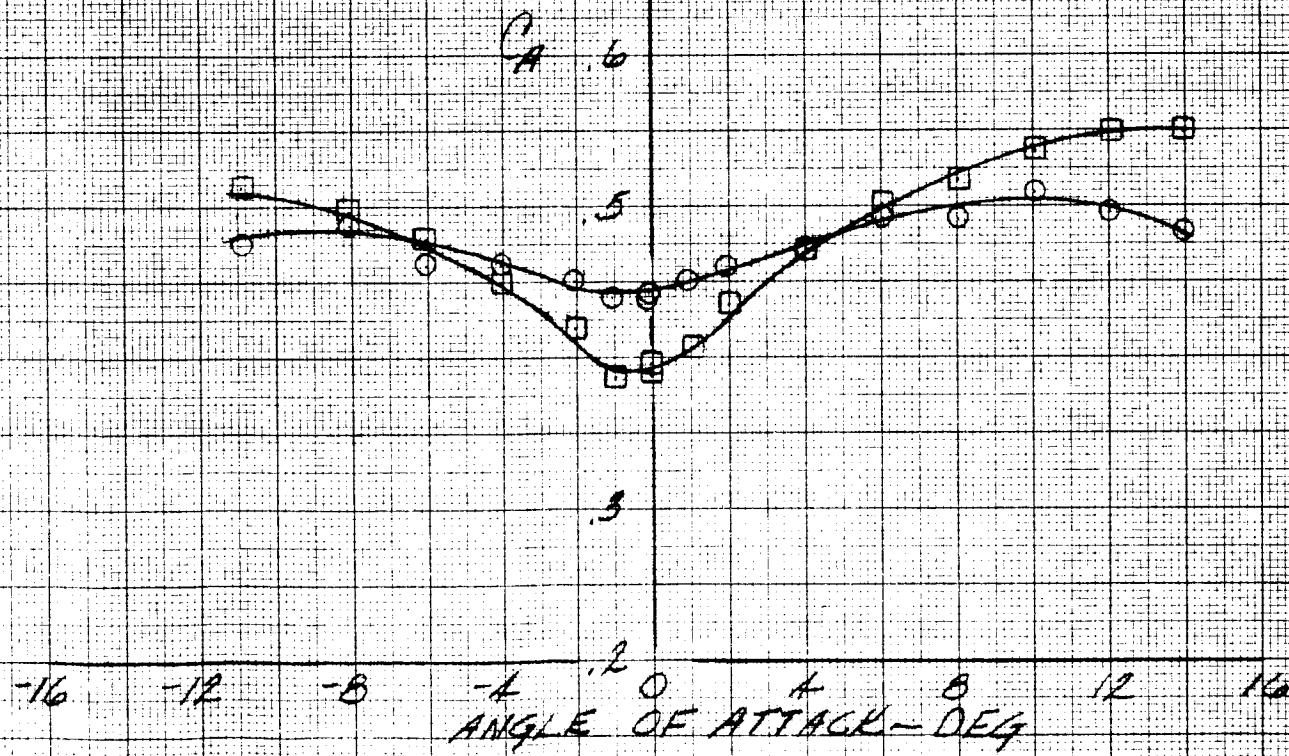
Model 12  
19 February 1963

LITTLE JOE II

Page 71  
Report No. GDC-63-025  
Figure 61

EFFECT OF WASHER ON  
LONGITUDINAL CHARACTERISTICS  
LANGLEY 8 FT. TRANSONIC PRESSURE TUNNEL  
MACH NO = 0.90

○ RUN 1 WASHER OFF  $\delta_{L4,3} = 0^\circ$   
□ RUN 2 WASHER ON  
(RN =  $3.98 \times 10^6$  PER FOOT)



EFFECT OF WASHER ON DYNAMIC CHARACTERISTICS  
LONG LENGTH TEST PRESSURE CYCLE  
MACH 1.2 ± 0.25

OPEN = WASHER OFF  
SOLID = WASHER ON  
CEN = 405 WOODED END

1.6

CW  
1.2

.8

.4

0

-4

-8

-1.2

-1.6

-16

-12

-8

-4

0

4

8

12

16

12

8

4

0

-4

-8

-12

-16

-20

-24

-28

-32

-36

-40

-44

-48

-52

-56

-60

-64

-68

-72

-76

-80

-84

-88

-92

-96

-100

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-692

-696

-700

-704

-708

-712

-716

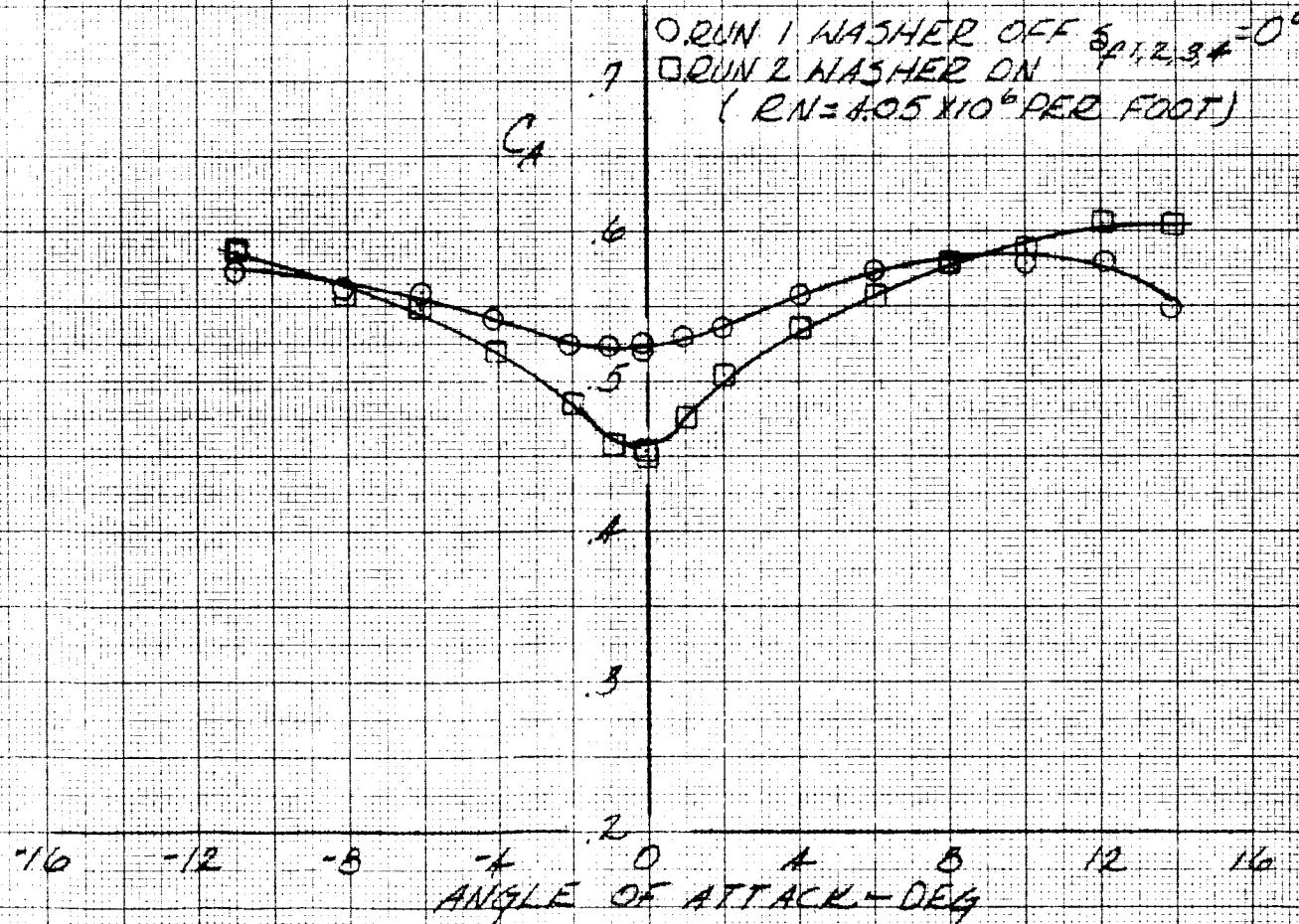
-720

Model 12  
19 February 1963

LITTLE JOE II

Page 73  
Report No. GDC-63-025  
Figure 63

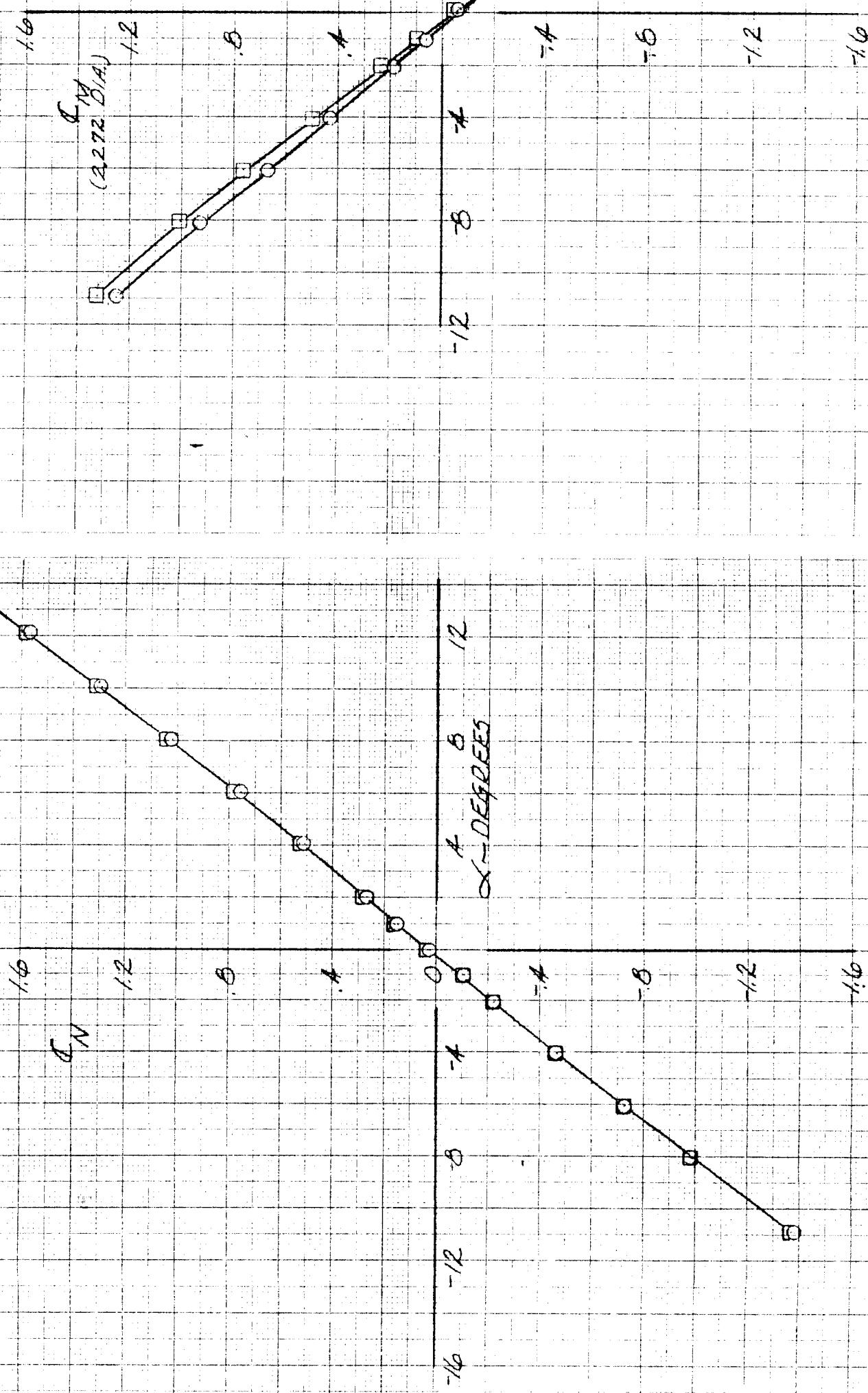
EFFECT OF WASHER ON  
LONGITUDINAL CHARACTERISTICS  
LANGLEY 8FT TRANSONIC PRESSURE TUNNEL  
MACH NO=0.95



LITTLE JOE II  
EFFECT OF WASHER ON LONGITUDINAL CHARACTERISTICS  
LONGEY, S AT TRANSOMIC PRESSURE TUNNEL  
MACH NO.: 1.00

RUN 1 WASHER OFF  
RUN 2 WASHER ON  
 $\rho V = 3.20 \text{ K/D PER FOOT}$

$S_1 Z_{34} = 0^\circ$



Model 12  
19 February 1963

LITTLE JOE II

Page 75  
Report No. GDC-63-025  
Figure 65

EFFECT OF WASHER ON  
LONGITUDINAL CHARACTERISTICS  
LANGLEY 8FT TRANSONIC PRESSURE TUNNEL  
MACH NO=1.00

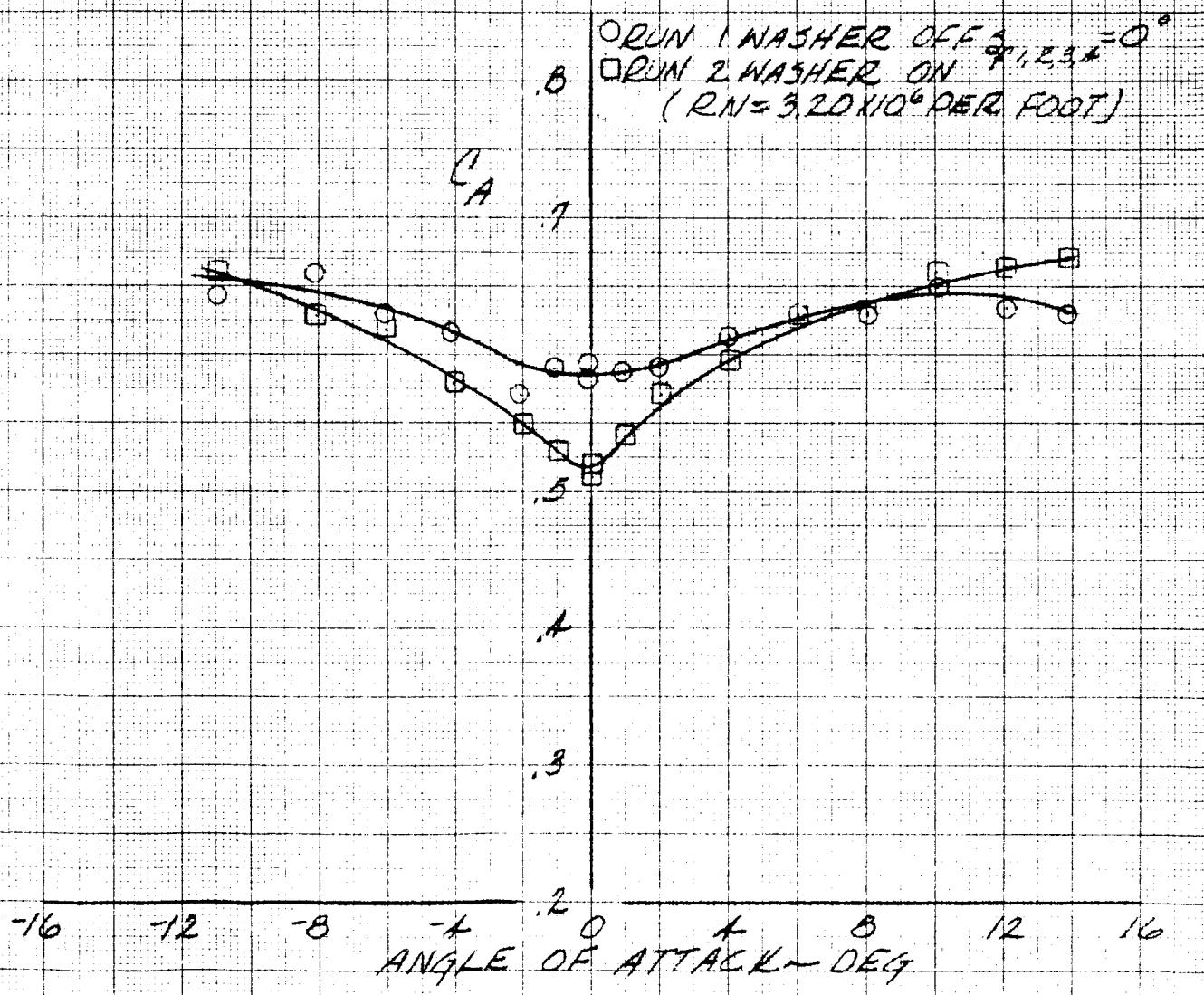
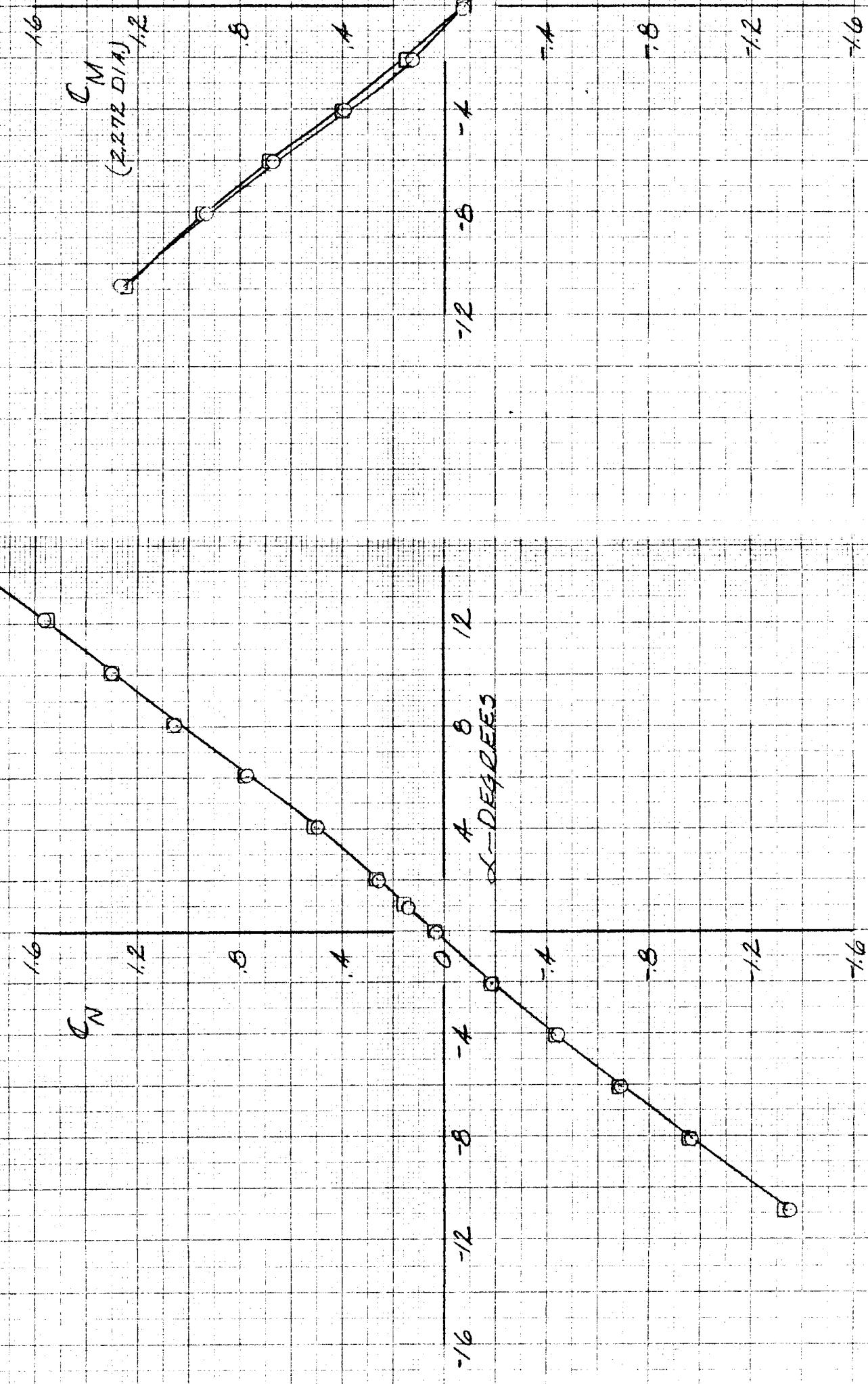


FIGURE 66

LITTLE JOE II  
EFFECT OF WASHER ON LONGITUDINAL CHARACTERISTICS  
ANGLE 84° TRANSONIC DENSITY TUNNEL  
MACC NO = 1/20

OPEN 1 WASHER DEE 5° 13.3° -0°  
OPEN 2 WASHER ON  
(RIN = 3.28 INCHES EACH)

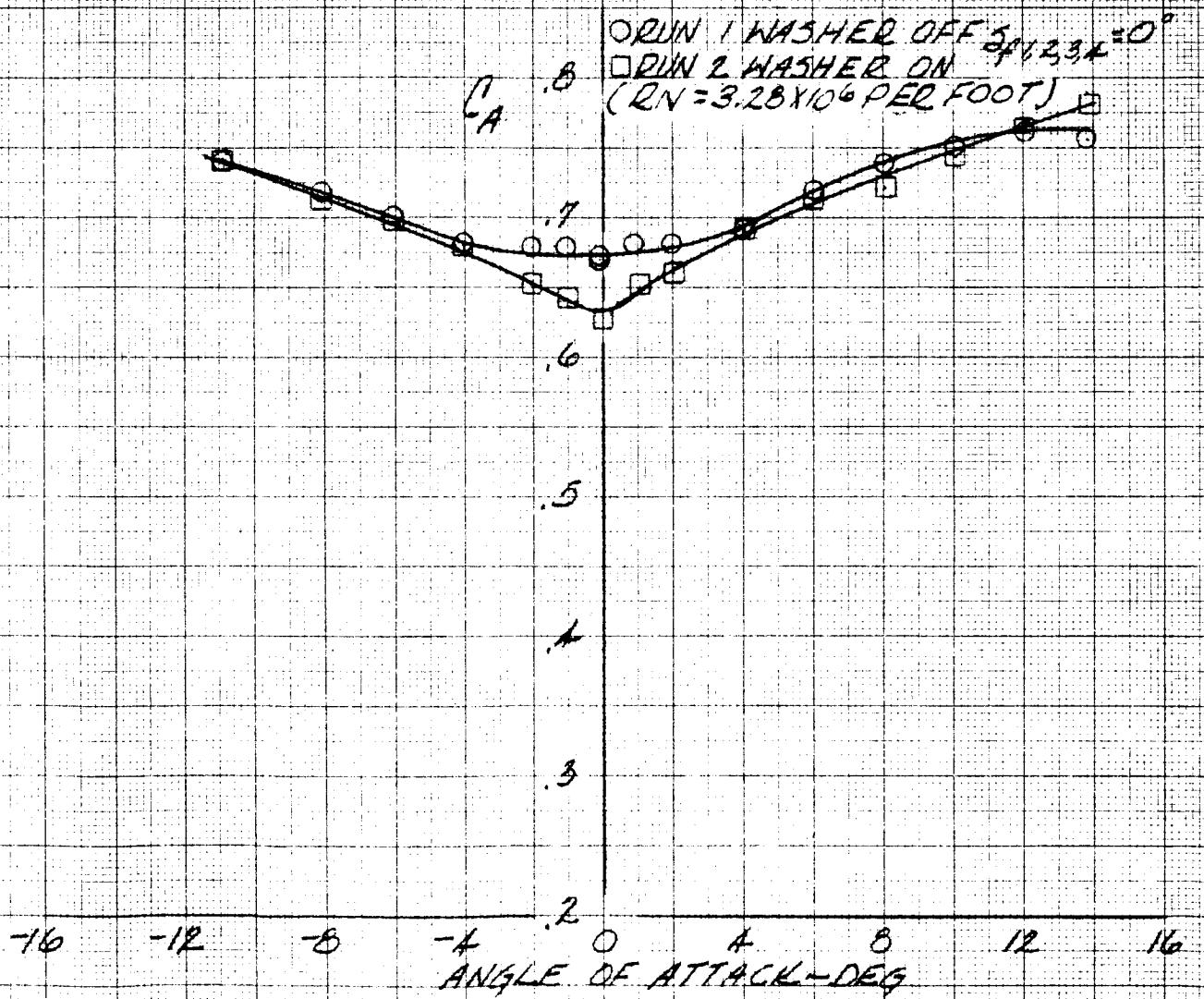


Model 12  
19 February 1963

LITTLE LIGE II

Page 77  
Report No. 33-625  
Figure 67

EFFECT OF WASHER ON  
LONGITUDINAL CHARACTERISTICS  
LANGLEY 8 FT TRANSONIC PRESSURE TUNNEL  
MACH NO = 1.20

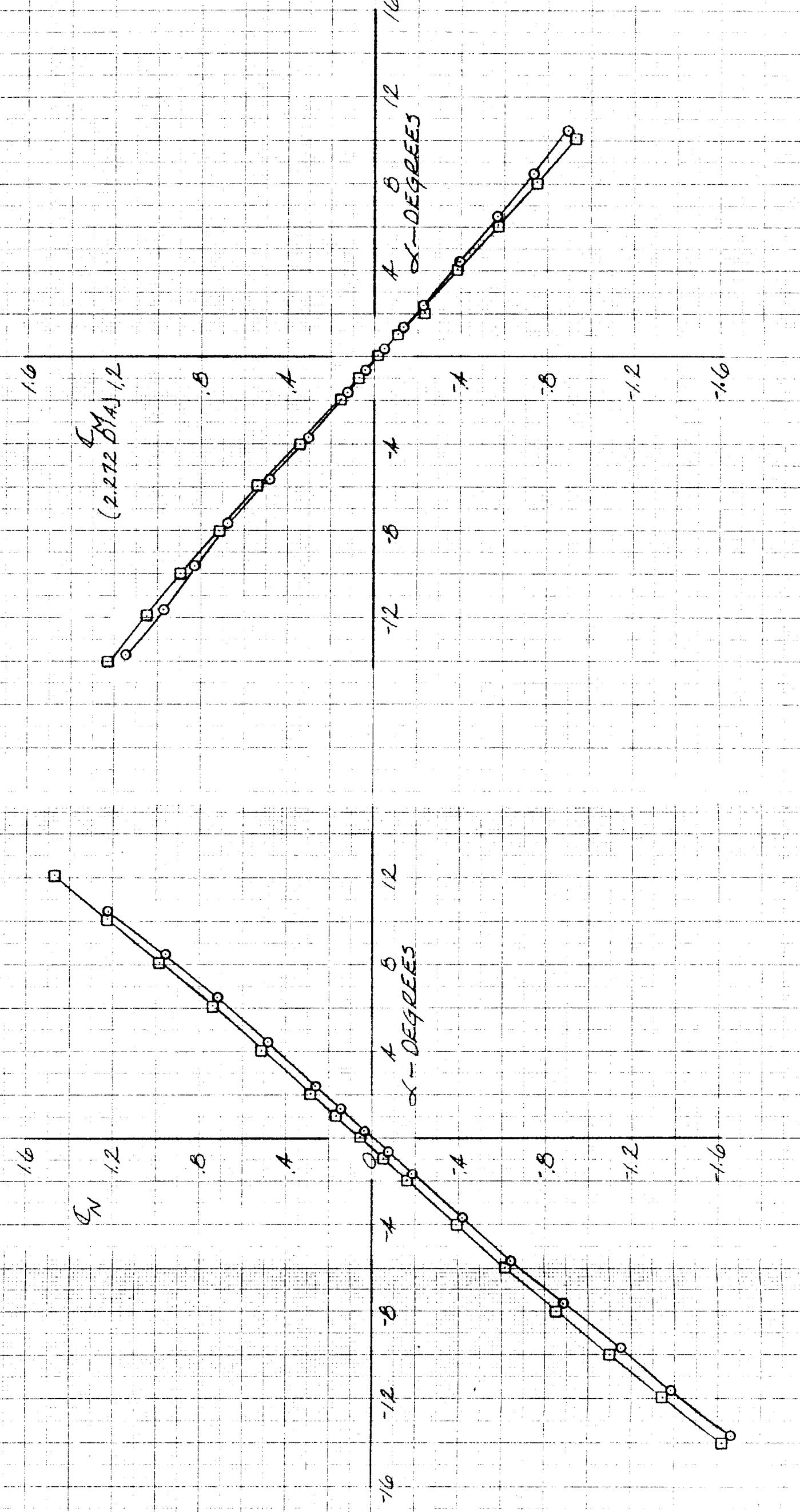


FIGURES 68

177E JOE II  
EFFECT OF WASHER ON DYNAMIC CHARACTERISTICS  
LANGLEY AERONAUTICAL RESEARCH CENTER  
MACH NO = 1.57

○ RUN 1 WASHER ON  
□ RUN 2 WASHER OFF  
(LEN = 2.50 INCHES FOOT)

$\delta_{\text{PSS}} = 0^\circ$

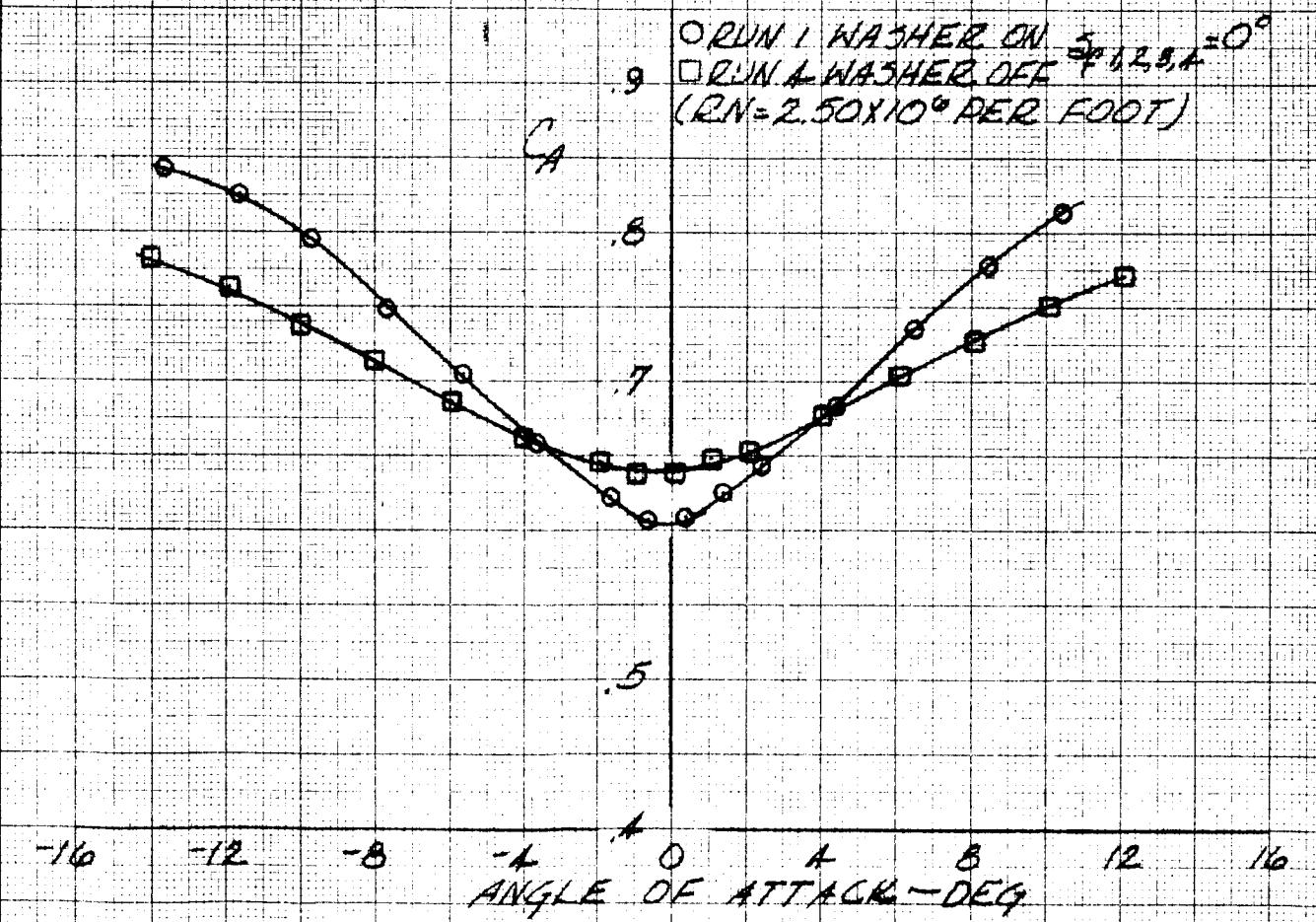


Model 12  
19 February 1963

LITTLE JOB 71

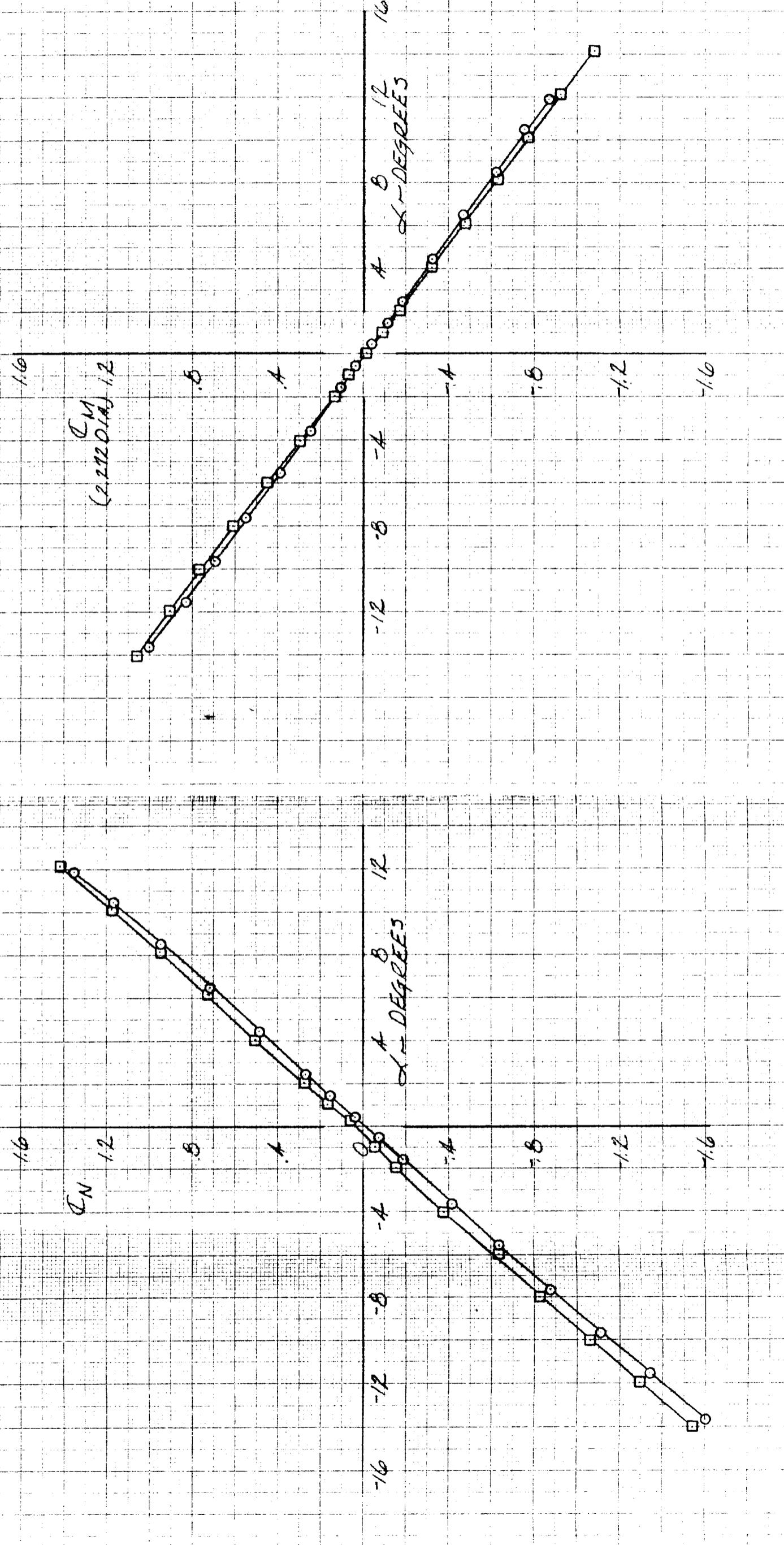
Page 79  
Report No. 680-63-025  
Figure 69

EFFECT OF WASHER ON  
LONGITUDINAL CHARACTERISTICS  
LANGLEY UNITARY PLAN SUPERSONIC TUNNEL  
MACH NO = 1.57



EFFECT OF ANGLED ON LOMONTIONAL CHARACTERISTICS  
LANGLEY UNIFLAME PLANE SUPERSONIC TUNNEL  
MACH NO = 1.80

O RUN 2 WASHER ON 5° 12' 34" + 0°  
□ RUN 5 WASHER OFF (RN = 2.50 X 10<sup>6</sup> DEP FOOT)



Model 12  
19 February 1963

LITTLE JOE II

Report No. GDC-63-025  
Figure 7A

EFFECT OF WASHER ON  
LONGITUDINAL CHARACTERISTICS  
LANGLEY UNITARY PLAN SUPERSONIC TUNNEL  
MACH NO=1.80

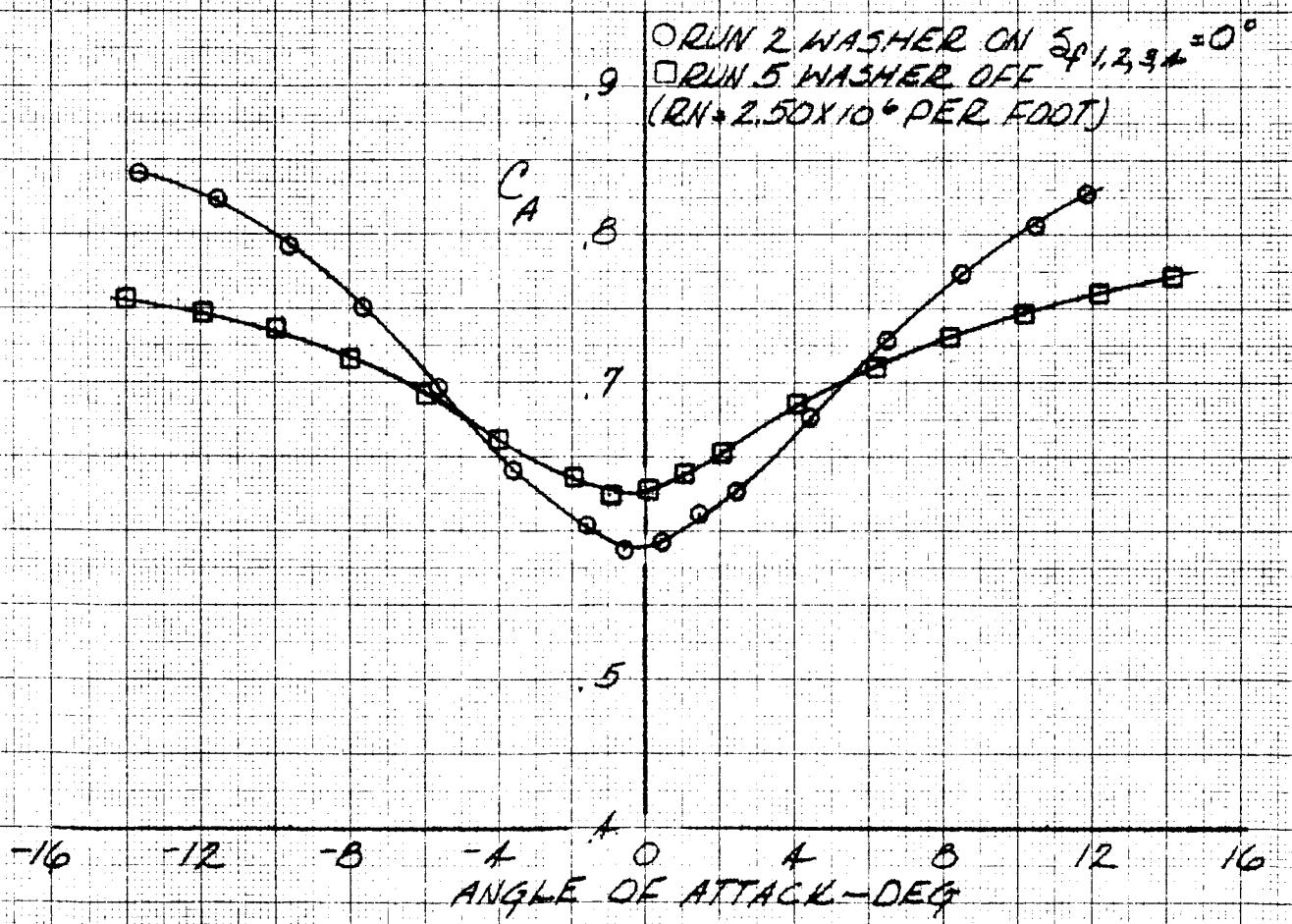
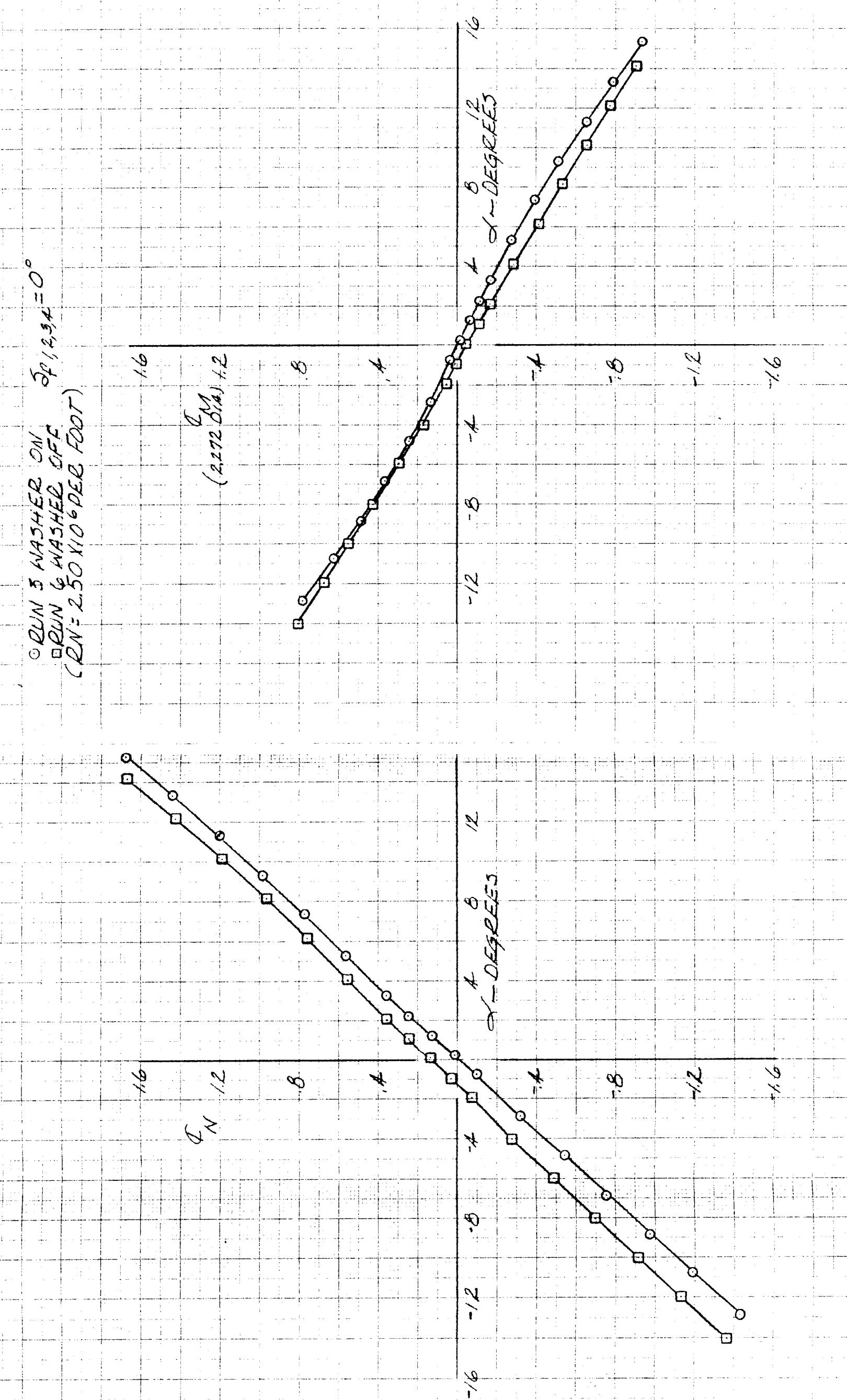


FIGURE 72

EFFECT OF WASHER ON LONGITUDINAL CHARACTERISTICS  
LANGE UNITS IN JET TUNNEL  
MACH NO. 2.16

○ RUN 5 WASHER ON  
□ RUN 6 WASHER OFF  
 $C_N = 2.50 \text{ X } 10^6 \text{ DEG FOOT}$

$\alpha = 0^\circ$



Model 12

19 February 1963

LITTLE JOE II

Page

83

Report No. GNC-63-025

Figure 73

EFFECT OF WASHER ON  
LONGITUDINAL CHARACTERISTICS  
LANGLEY UNITARY PLAN SUPERSONIC TUNNEL  
MACH NO = 2.10

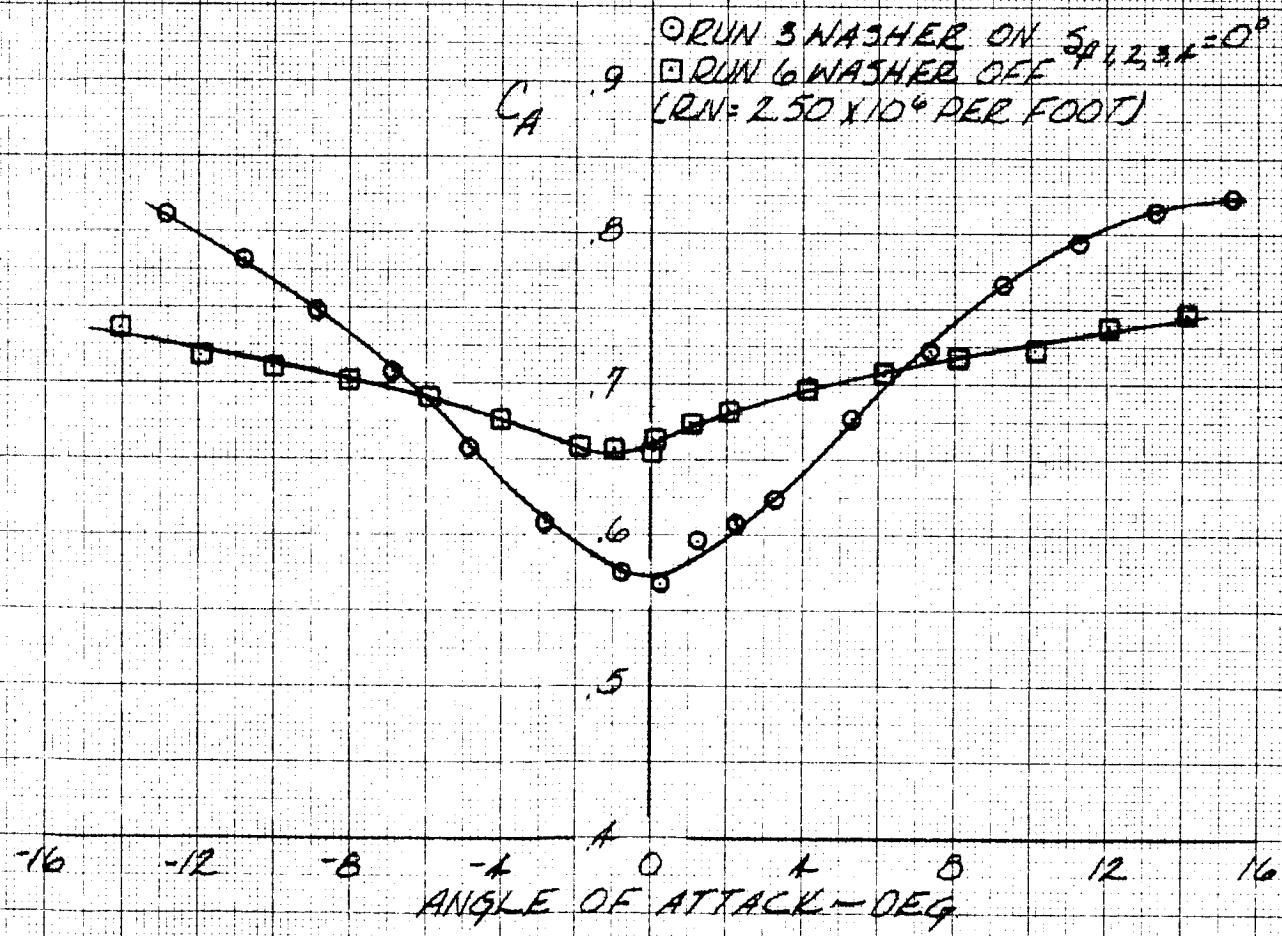
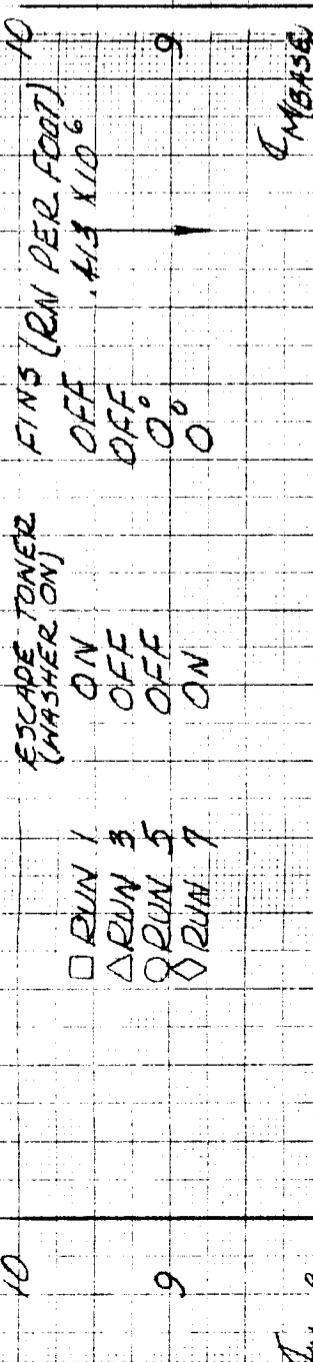


FIGURE 74

EFFECT OF FINS ON  
LONGITUDINAL  
CHARACTERISTICS  
LAWLEY TEST LOW SPEED TUNNEL  
 $f = 5.75$  MACH NO. 0.625



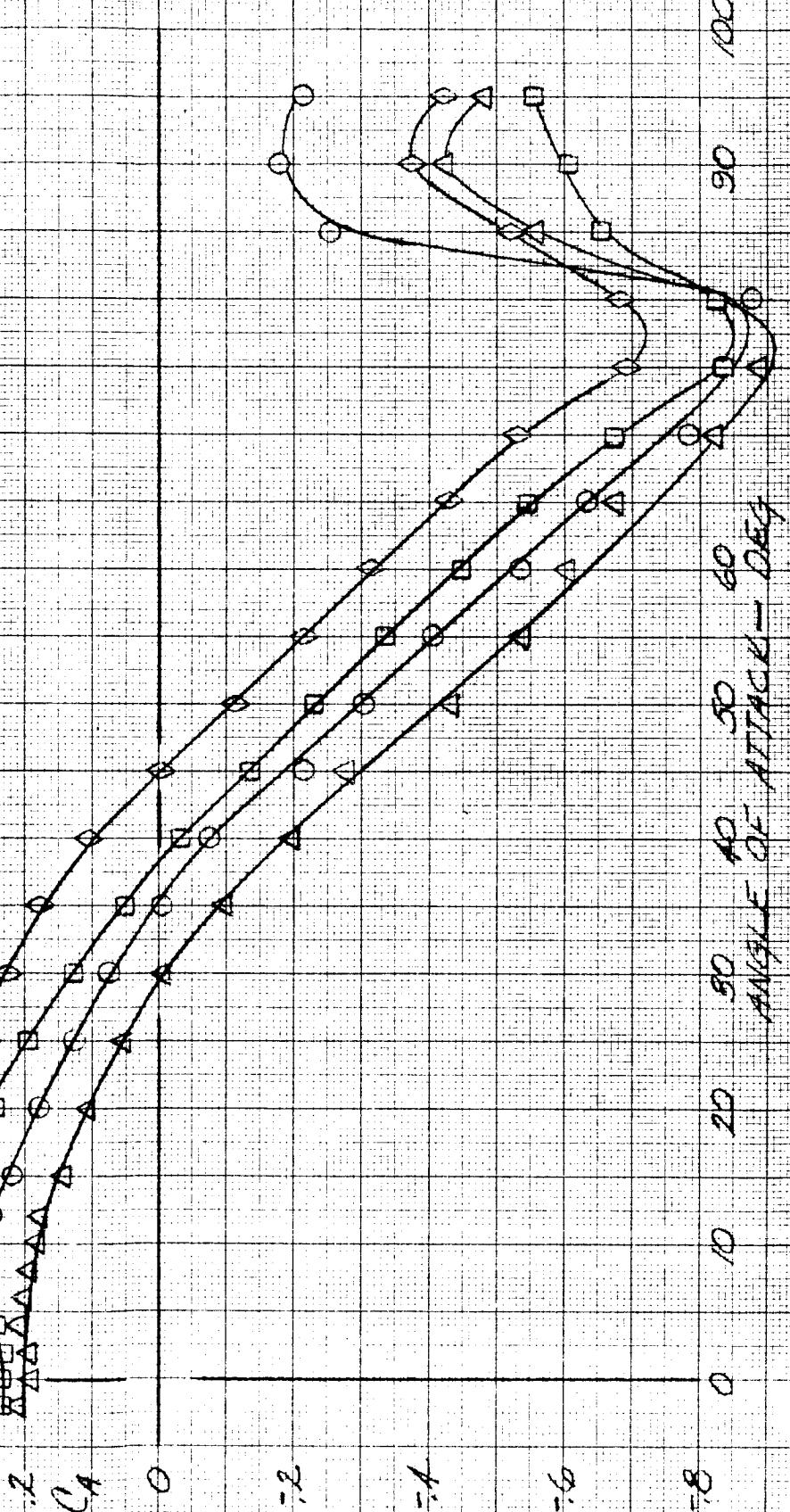
Model 12  
19 February 1963

Page 85  
Report No. GDC-63-025  
Figure 75

EFFECT OF ESCAPE TOWER AND FINNS ON  
LONGITUDINAL CHASIS TEST  
COMPLEX RIDE ON COAST

ESCAPE TOWER HIGH MACH 2.5  
FINNED COAST 13 X 10<sup>6</sup> g = 5.75

FINNED COAST 0.5°  
FINNED COAST 0.0°  
FINNED COAST -0.5°  
FINNED COAST -1.0°

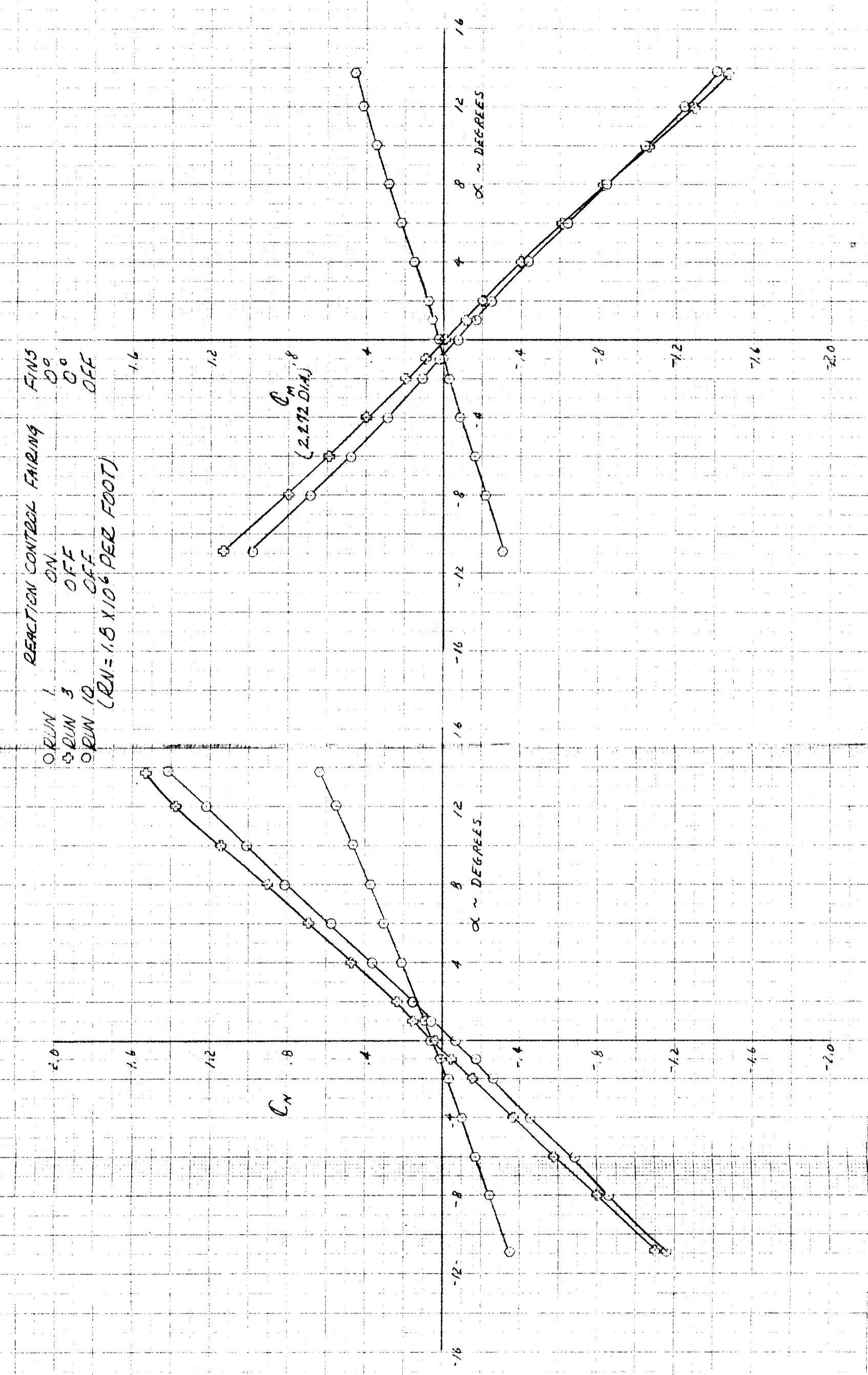


GENERAL DYNAMICS CONVAIR

Model 12 Date 19 February 1983

EFFECT OF REACTIONARY CONTROL FACING AND  
FINS ON LONGITUDINAL CHARACTERISTICS  
ANGLE OF TRANSonic PRESSURE TUNNEL  
WALL OFF MACH NO = 0.30

REACTION CONTROL FAIRING GUNS  
 OPEN 1 ON 0°  
 OPEN 2 OFF 0°  
 OPEN 10 OFF OFF  
 $(RN = 1.8 \times 10^6 \text{ PER FOOT})$



Model 12  
19 February 1963

LITTLE JOE II

Page 87  
Report No. GRC-63-025  
Figure 71

EFFECT OF REACTION CONTROL FAIRINGS  
AND FINS ON LONGITUDINAL CHARACTERISTICS  
LANGLEY 8FT TRANSONIC PRESSURE TUNNEL  
WASHER OFF MACH NO = 0.90

REACTION CONTROL FAIRINGS      FINS  
○ RUN 1      ON      0°  
○ RUN 3      OFF      0°  
○ RUN 10      OFF      OFF  
(RN =  $1.8 \times 10^6$  PER FOOT)

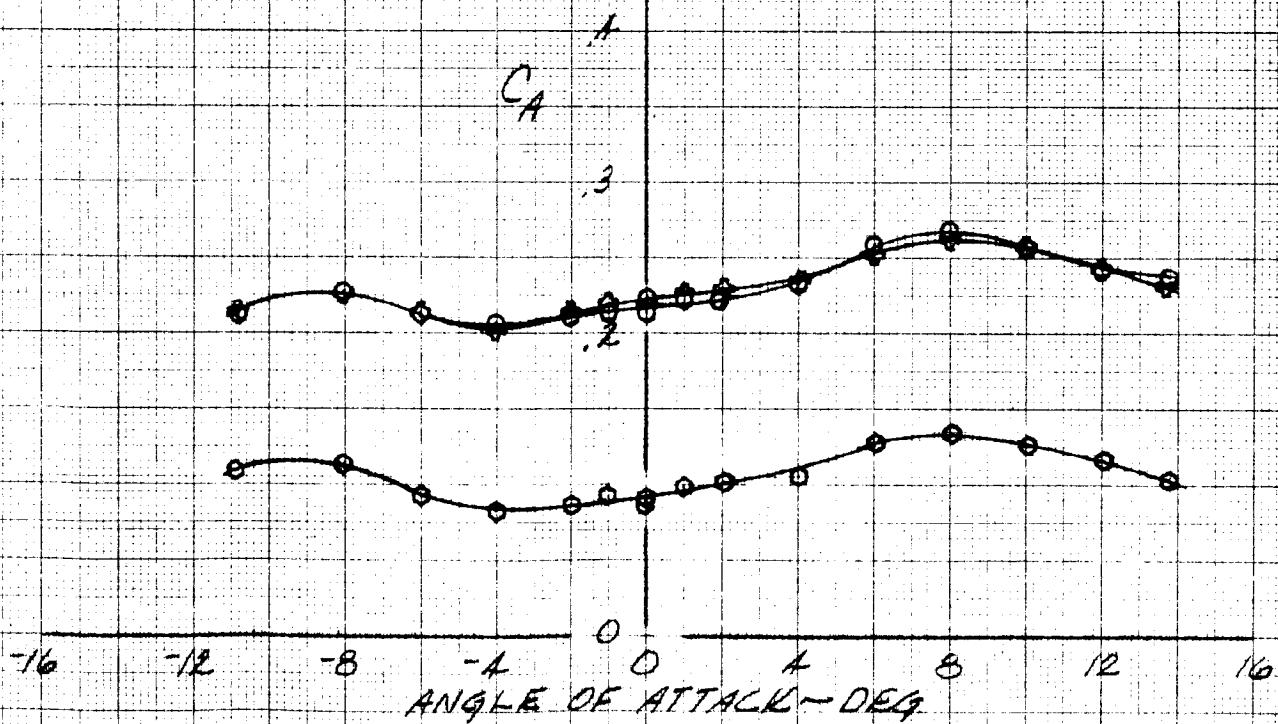
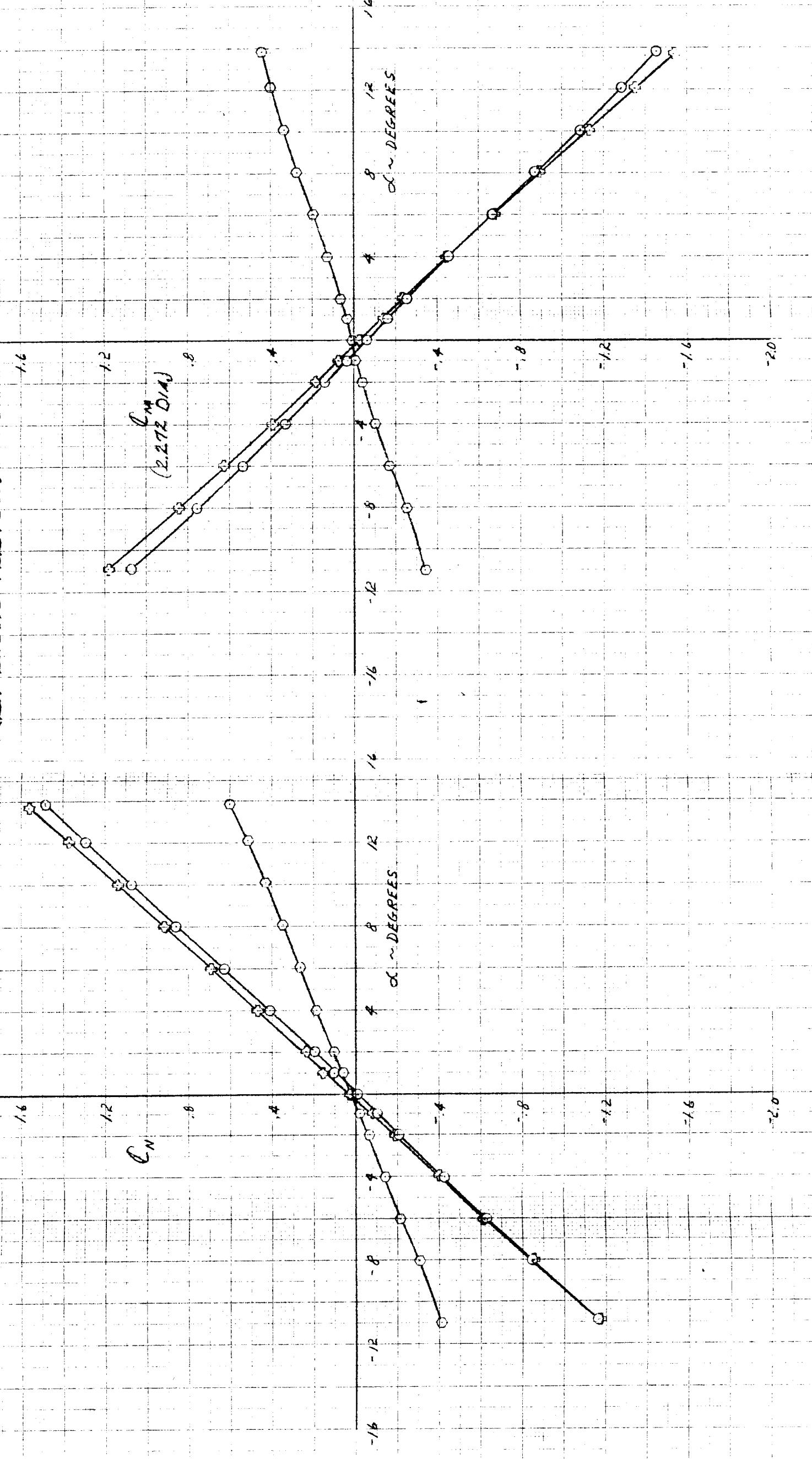


FIGURE 78

L111E 4/25/62  
EFFECT OF REACTION CONTROL FINES ON  
FINS ON LONGITUDINAL CRASH TESTISTICS  
LANGLEY SAT TANSONIC PRESSURE TUNNEL  
WASHER OFF  
MACH NO: 0.50

REACTION CONTROL FINES  
FIN 5  
0°  
OFF  
OFF  
OPEN 1  
OPEN 3  
OPEN 10  
(CN = 2.76 X 10<sup>-6</sup> PER FOOT)



Model 12  
19 February 1963

LITTLE JOE II

Page 89  
Report No. GTR-63-025  
Figure 79

EFFECT OF REACTION CONTROL FAIRINGS  
AND FINS ON LONGITUDINAL CHARACTERISTICS  
LANGLEY 8FT TRANSONIC PRESSURE TUNNEL  
WASHER OFF MACH NO = 0.50

REACTION CONTROL FAIRINGS      FINS  
RUN 1      ON      0°  
RUN 3      OFF      0°  
RUN 10      OFF      OFF  
(RN = 2.76 X 10<sup>6</sup> PER FOOT)

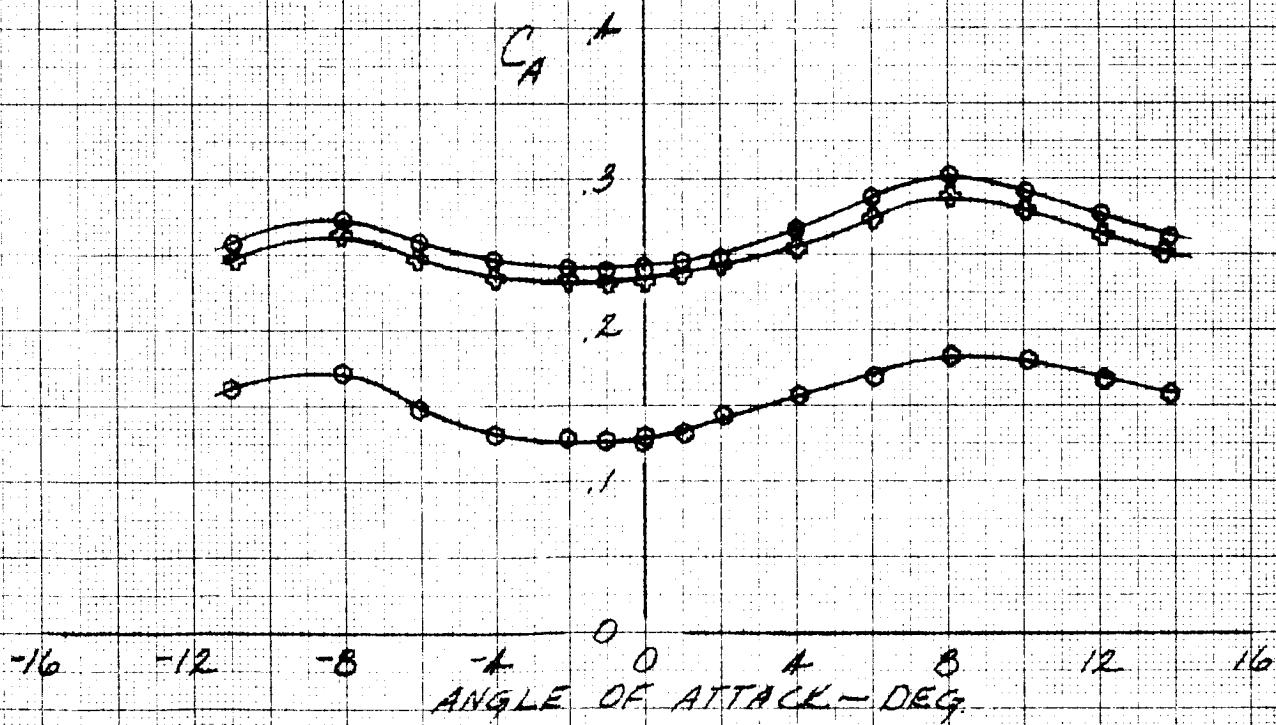
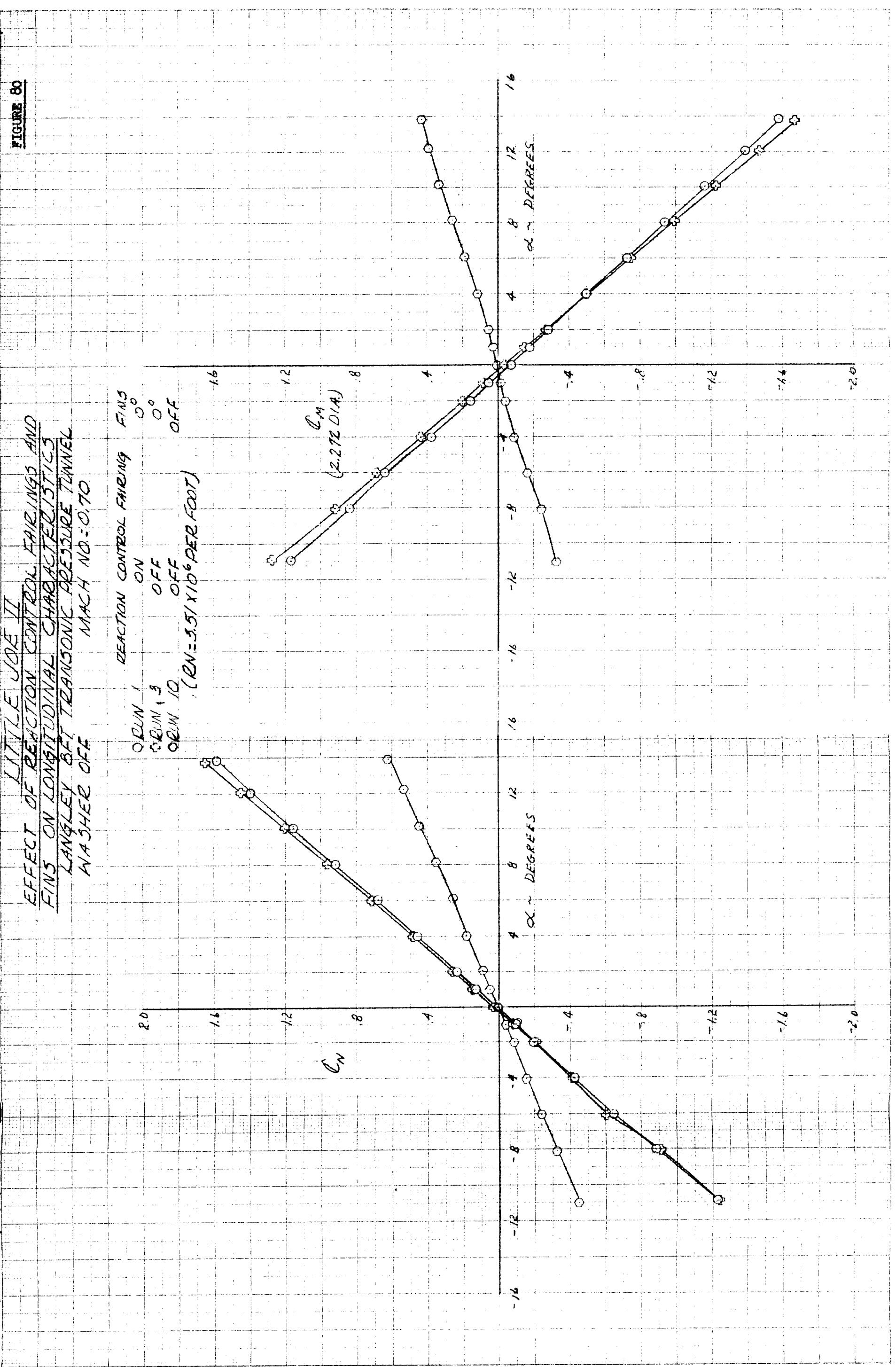


Figure 80



Model 12  
19 February 1963

LITTLE JOE II

Page

91

Report No. CGD-63-025  
Figure 81

EFFECT OF REACTION CONTROL FAIRINGS  
AND FINS ON LONGITUDINAL CHARACTERISTICS  
LANGLEY 8FT TRANSONIC PRESSURE TUNNEL  
WATER OFF  
MACH NO = 0.70

REACTION CONTROL FAIRINGS FINS  
○ RUN 1      ON      0°  
★ RUN 3      OFF      0°  
○ RUN 10      OFF      OFF

(RN =  $3.51 \times 10^6$  PER FOOT)

.5

CA

.4

.1

0

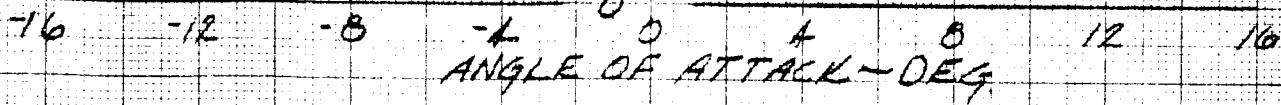
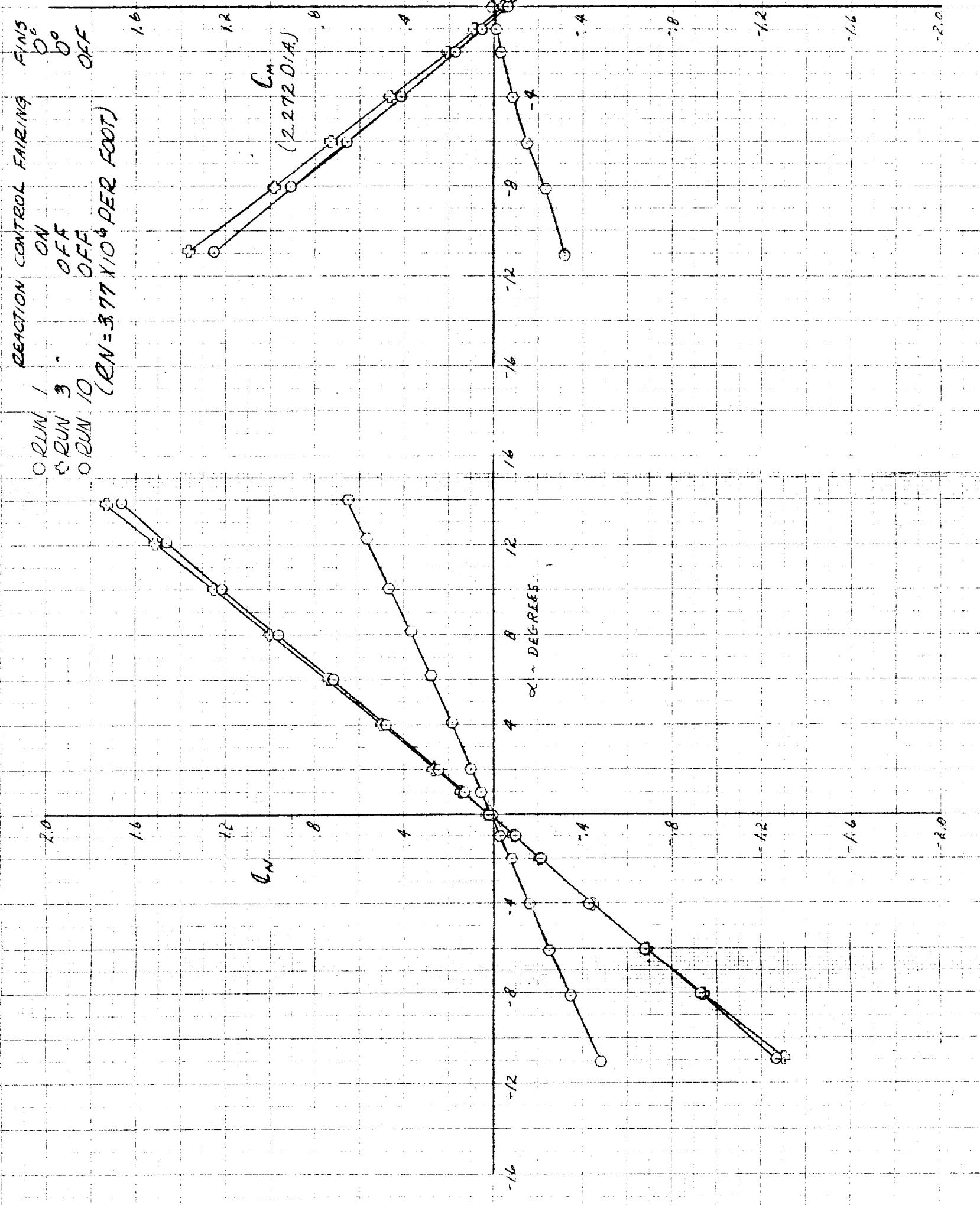


FIGURE 8c

LITTLE JOE II  
EFFECT OF REACTION CONTROL FAIRINGS AND  
FINS ON LONGITUDINAL CHARACTERISTICS  
LANGLEY 8 FT TRANSONIC FREE-SWEEPE TUNNEL  
FLASHED OFF

REACTION CONTROL FAIRING FINS  
ON  
OFF  
OFF  
OPEN 10°  
 $C_{L0} = 3.77 \text{ X } 10^4 \text{ PER FOOT}$



Model 12  
19 February 1963

LITTLE JOE II

Page 93  
Report No. GDC-63-025  
Figure 83

EFFECT OF REACTION CONTROL FAIRINGS  
AND FINS ON LONGITUDINAL CHARACTERISTICS  
LANGLEY 8FT TRANSONIC PRESSURE TUNNEL  
WASHER OFF MACH NO = 0.80

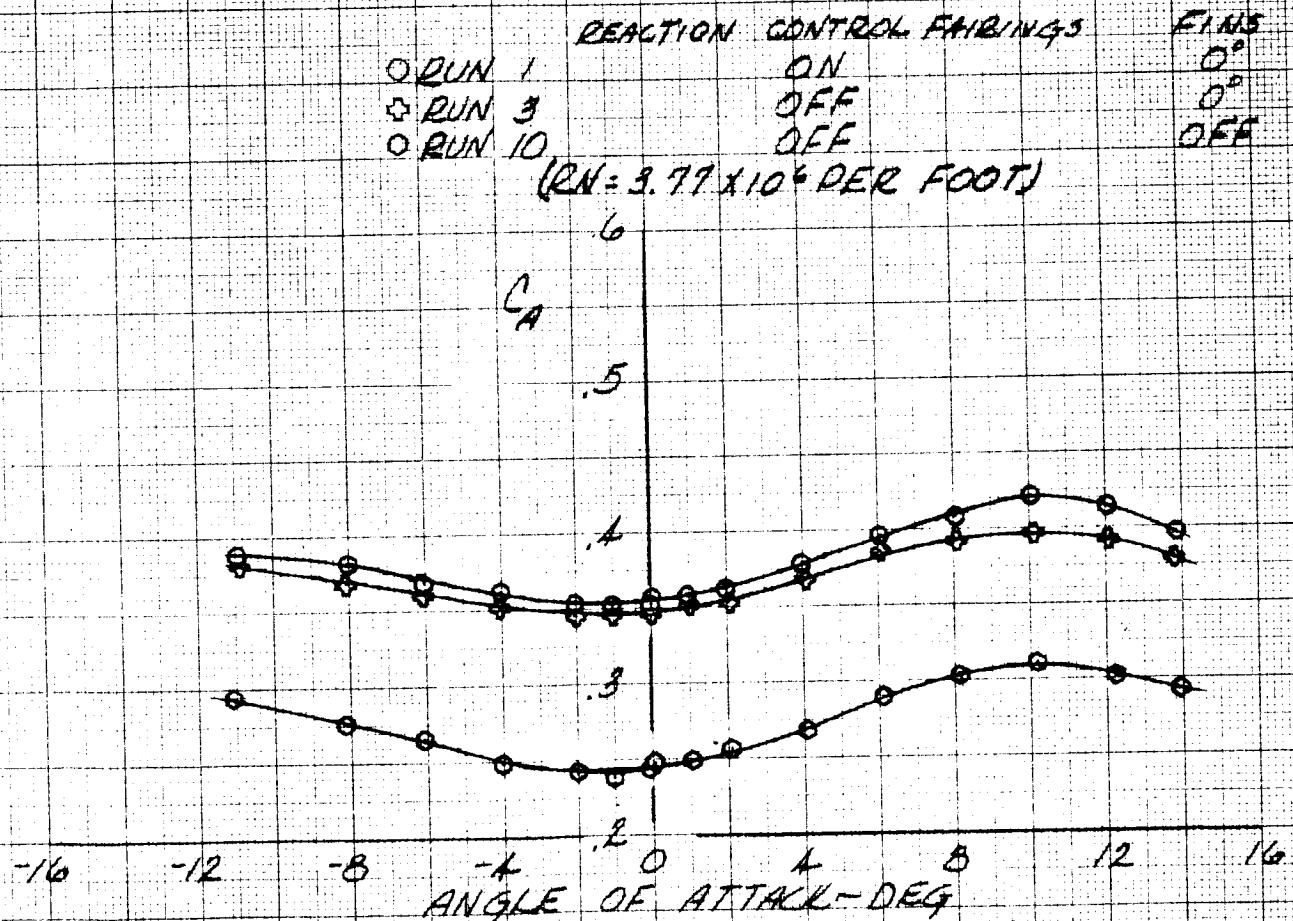
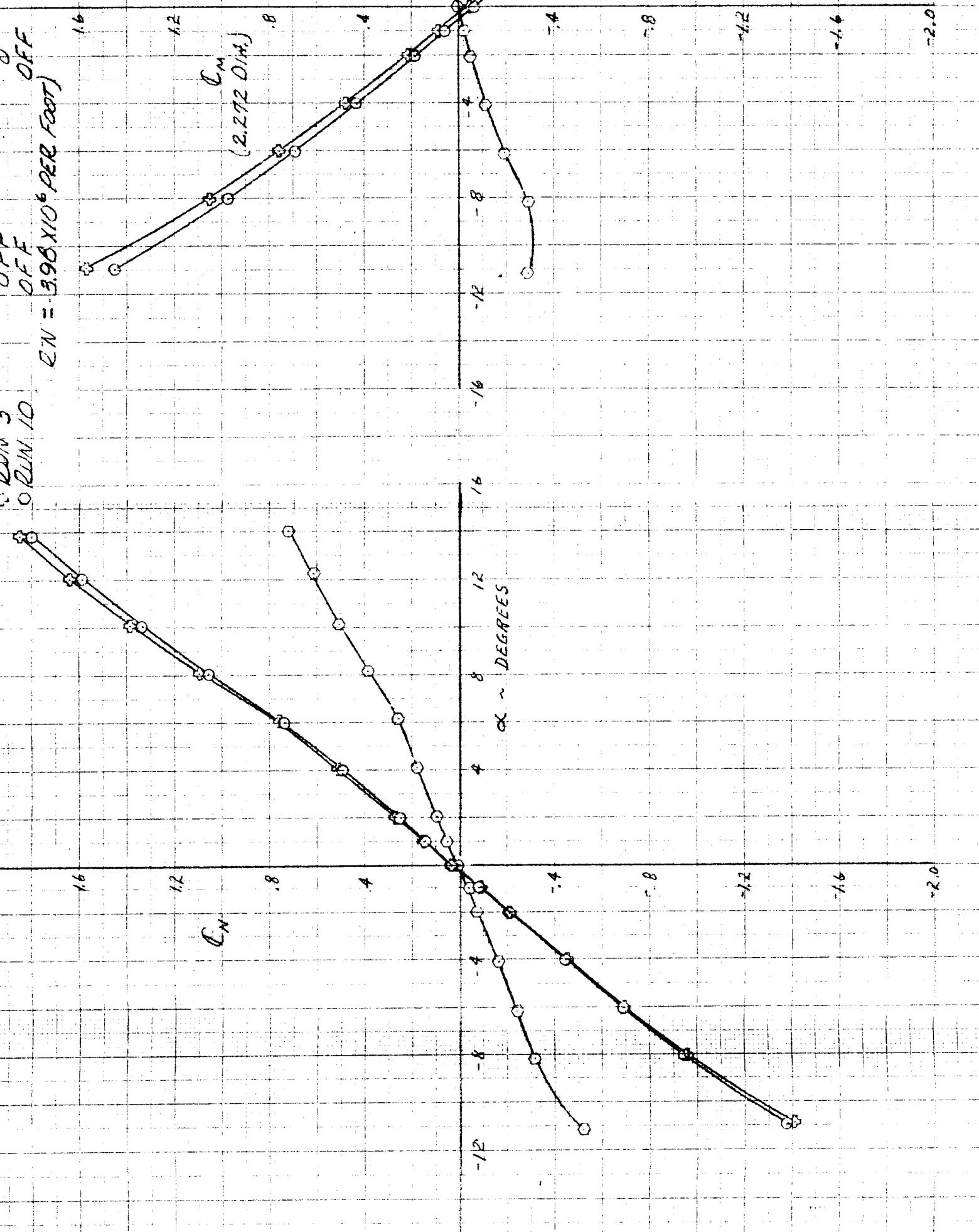


FIGURE 84

LITTLE USE OF REACTION CONTROL FAIRINGS AND FINS ON LONGITUDINAL CHARACTERISTICS  
LANGLEY FET TRANSONIC PRESSURE TUNNEL  
WAGNER OFF MACH NO = 0.90

REACTION CONTROL FAIRINGS  
RUN 1 ON OFF OFF  
RUN 3 ON OFF OFF  
RUN 10 ON OFF OFF  
 $C_N = 3.98 \times 10^6 \text{ PER FOOT}$



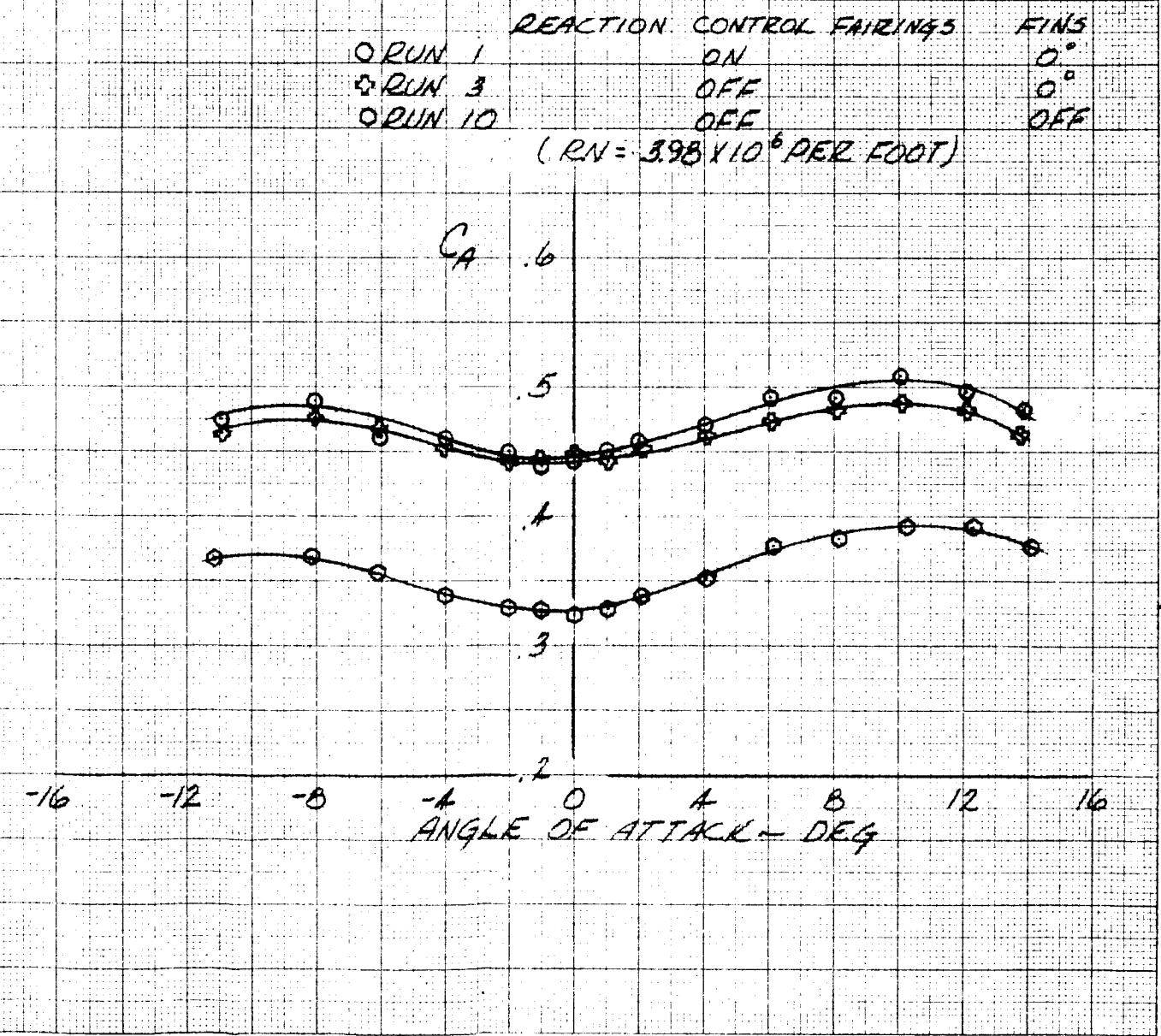
Model 12  
Date 19 February 1965

Model 12  
19 February 1963

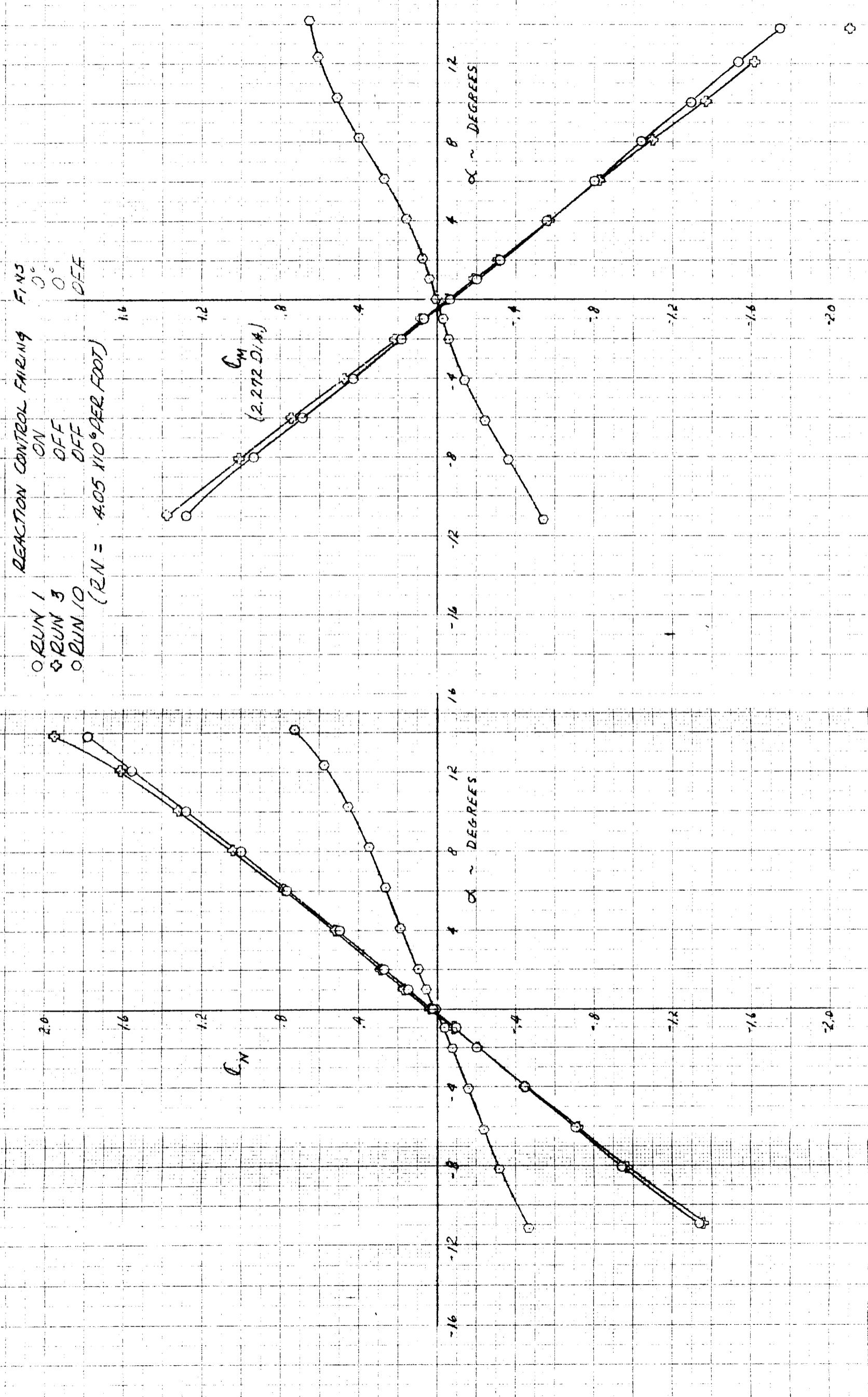
LITTLE JOE II

Page 95  
Report No. GDC-63-025  
Figure 6

EFFECT OF REACTION CONTROL FAIRINGS  
AND FINS ON LONGITUDINAL CHARACTERISTICS  
LANGLEY 8FT TRANSONIC PRESSURE TUNNEL  
WASHER OFF MACH NO = 0.90



LITTLE 4057  
EFFECT OF REACTION CONTROL SPRAYING AND  
FINS ON LONGITUDINAL CHAOTIC STICKS  
LANGLEY SET TRANSONIC PRESSURE TUNNEL  
WASHERS OF  
MACH NO.: 0.95

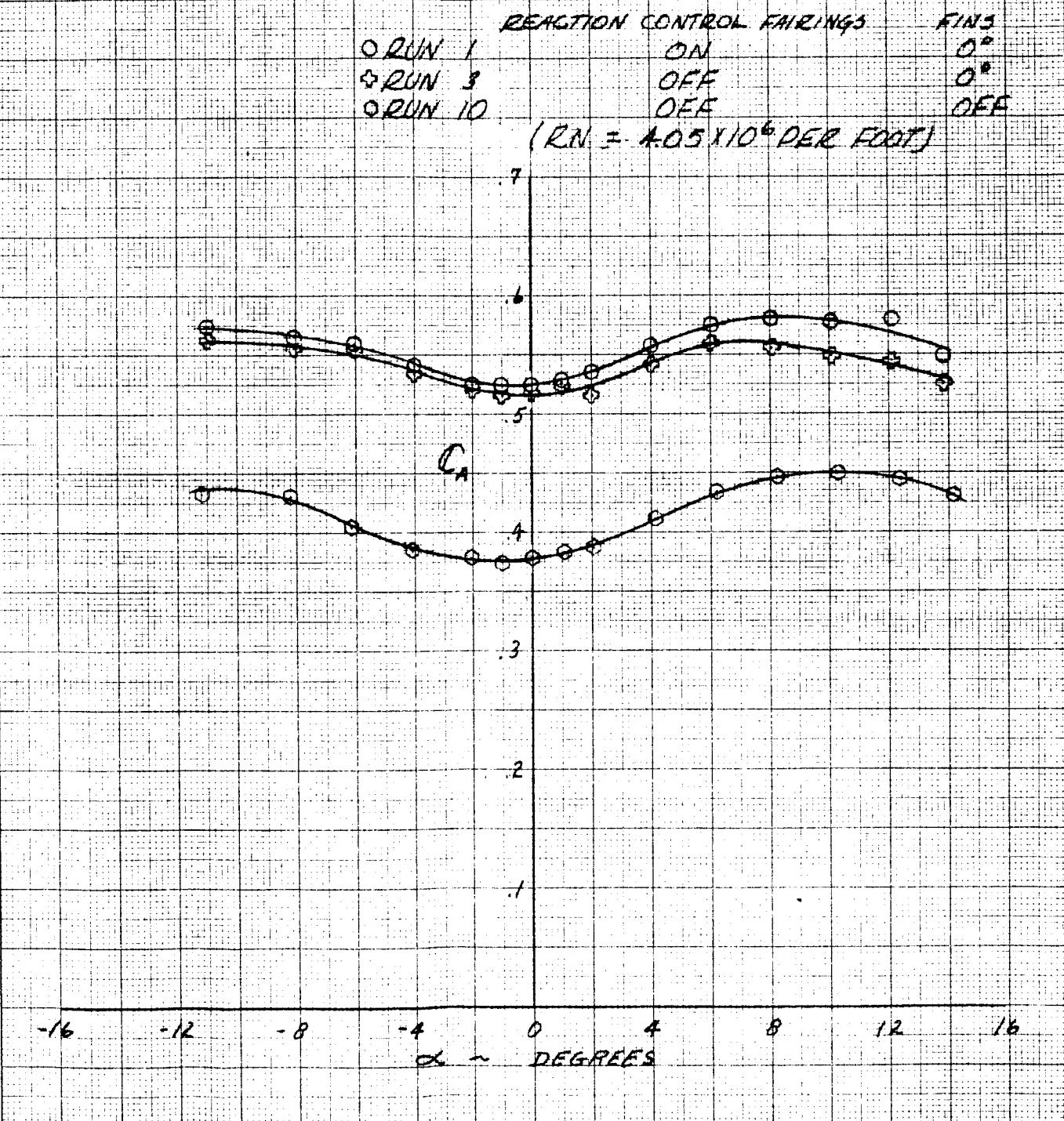


Model 12  
19 February 1963

LITTLE JOE II

Page 97  
Report No. GRC-63-025  
Figure 87

EFFECT OF REACTION CONTROL FAIRINGS  
AND FINS ON LONGITUDINAL CHARACTERISTICS  
LANGLEY BFT TRANSONIC PRESSURE TUNNEL  
WASHER OFF MACH NO = 0.95

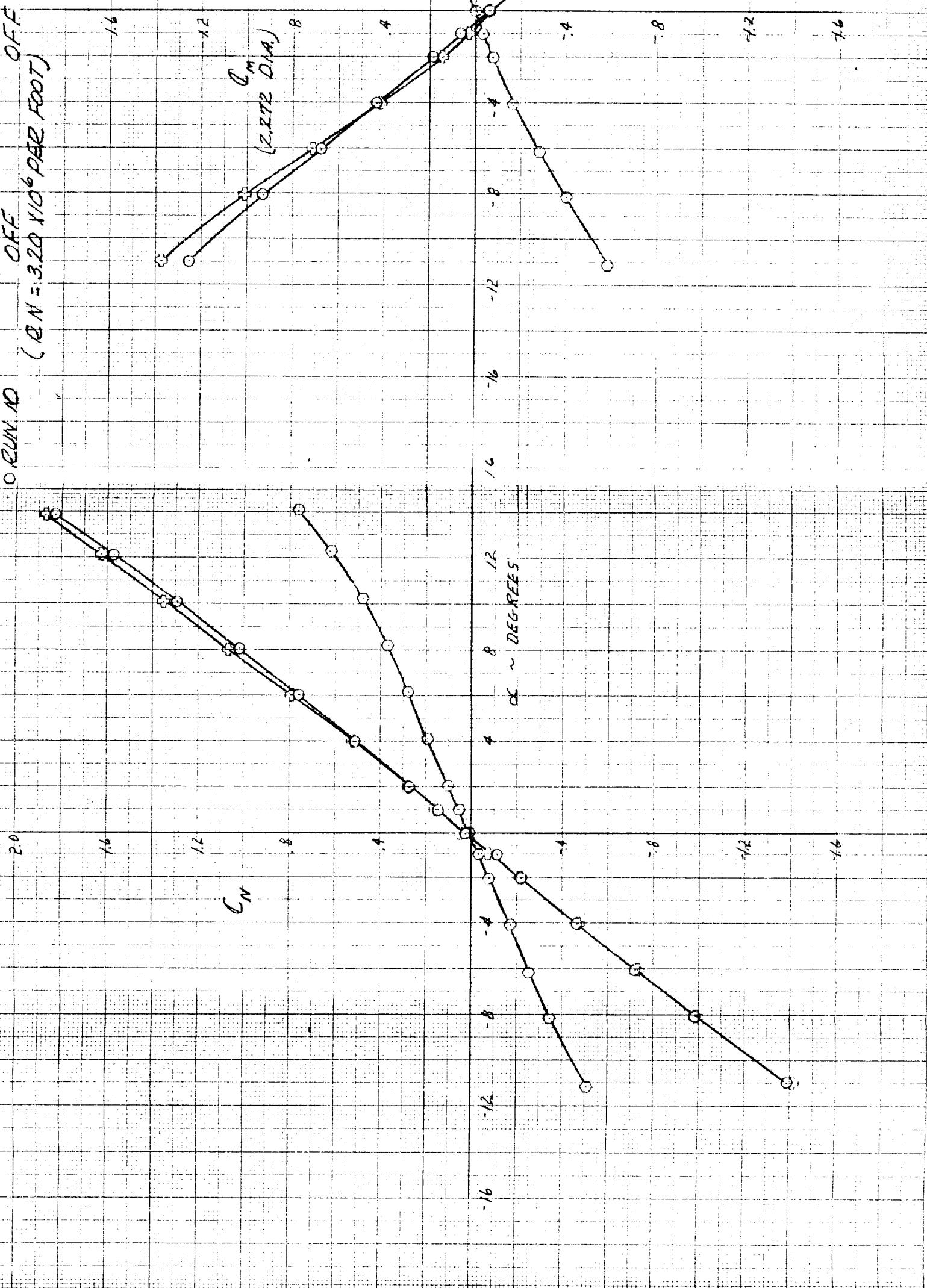




L172 E. JOE 77  
EFFECT OF REACTION CONTROL SPRINGS AND  
FINS ON LONGITUDINAL CHARACTERISTICS  
LANGLEY 8x7 TRANSONIC DOME TUBE TUNNEL  
WASHER OFF MACH NO.: 1.00

FIGURE 88

REACTION CONTROL FAIRING FINS  
ON  
OFF  
OFF  
OFF  
RUN 1  
RUN 3  
RUN 10 ( $C_N = 3.20 \times 10^6$  PER FOOT)

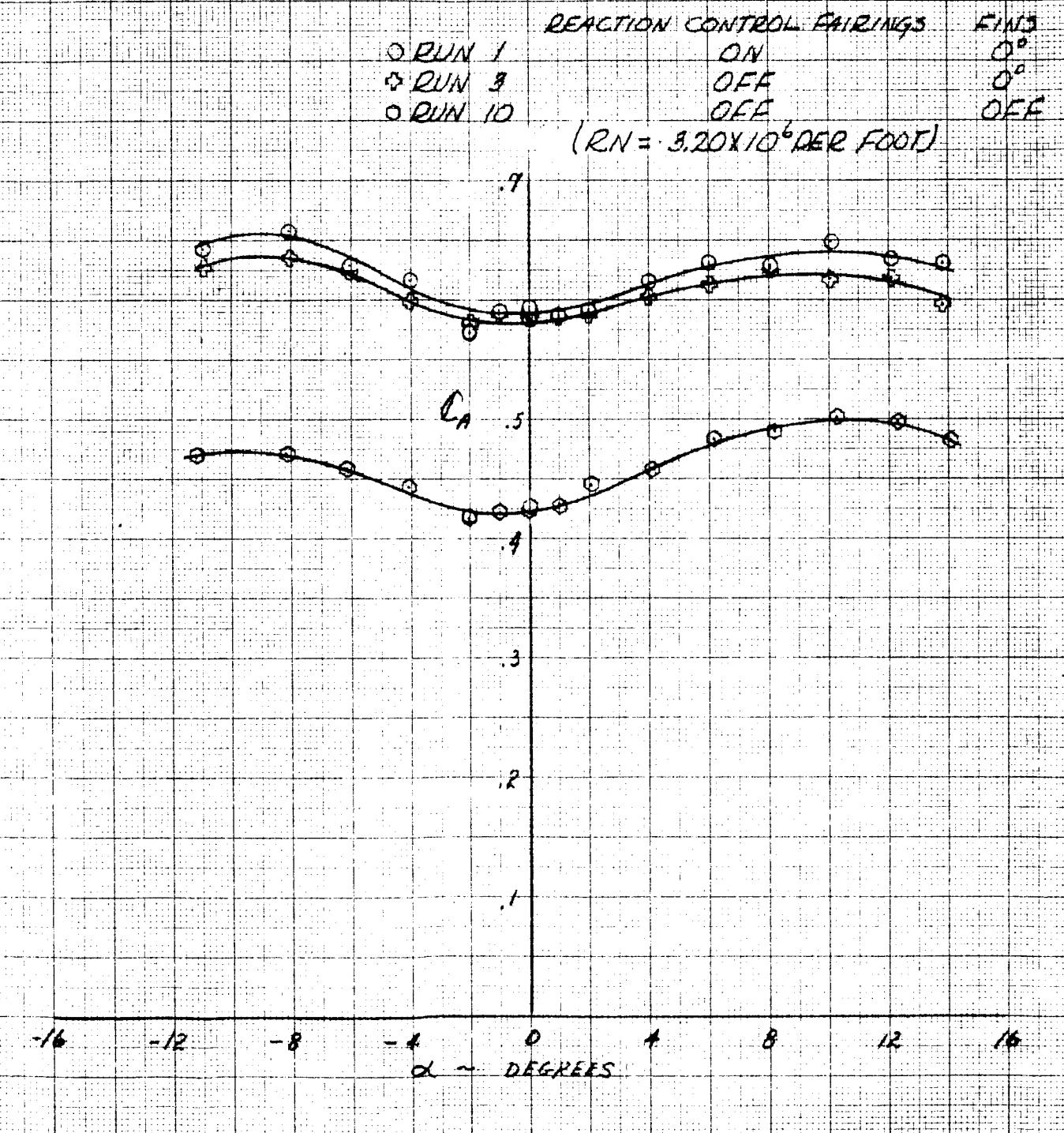


Model 12  
19 February 1963

LITTLE JOE II

Page 99  
Report No. GDC-63-025  
Figure 89

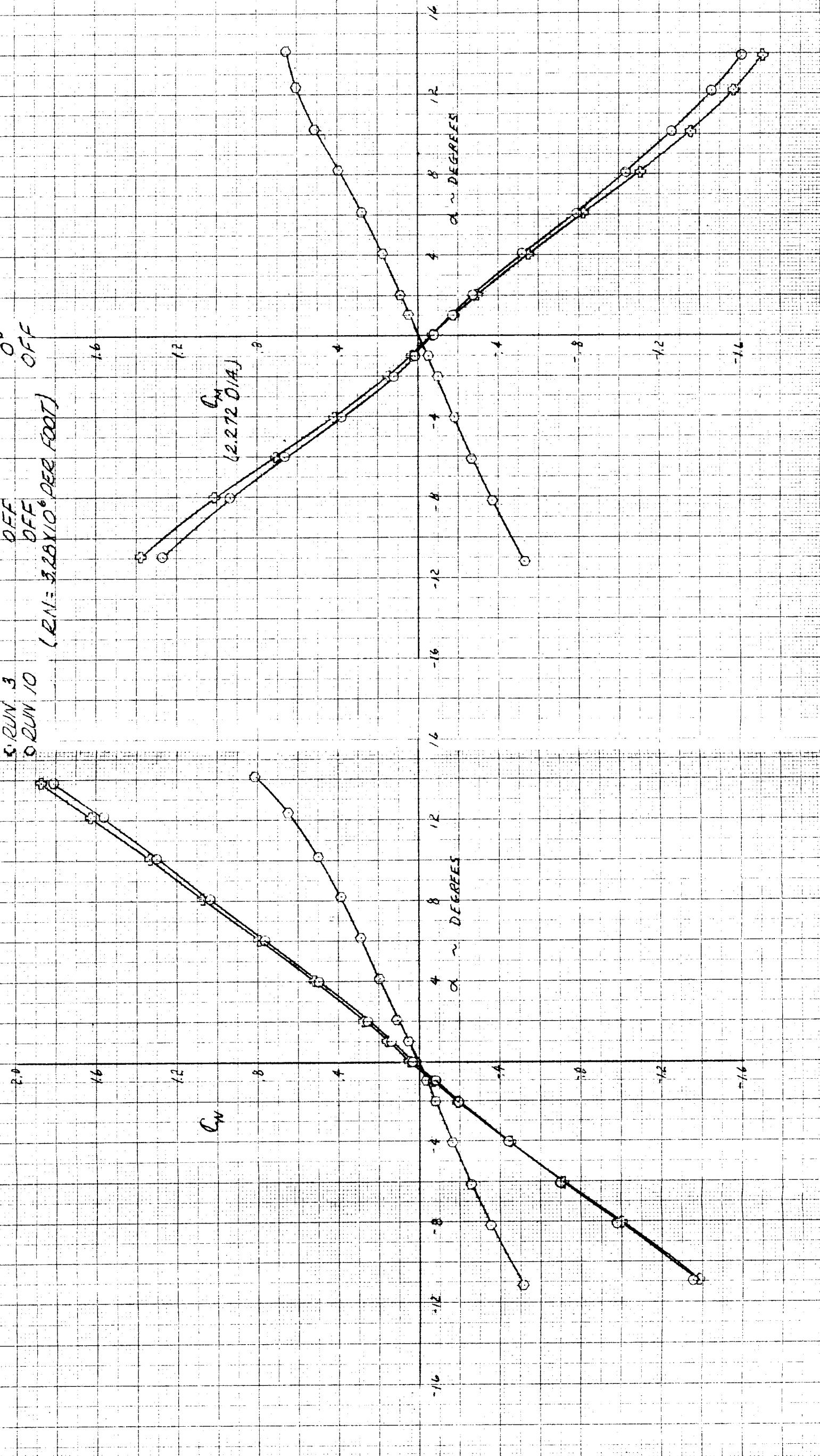
EFFECT OF REACTION CONTROL FAIRINGS  
AND FINS ON LONGITUDINAL CHARACTERISTICS  
LANGLEY BET TRANSONIC PRESSURE TUNNEL  
WASHER OFF MACH NO=1.00



EFFECT OF POSITION CONTROL FAIRINGS AND  
FINS ON LONGITUDINAL CHARACTERISTICS  
LAWLEY BET TRANSONIC PRESSURE TUNNEL  
WASHER OFF MACH NO = 1.20

REACTION CONTROL FAIRINGS		AIMS
02UN	1	ON
02UN	3	OFF
02UN	10	OFF

(B11 = 328110° DEG EAST)



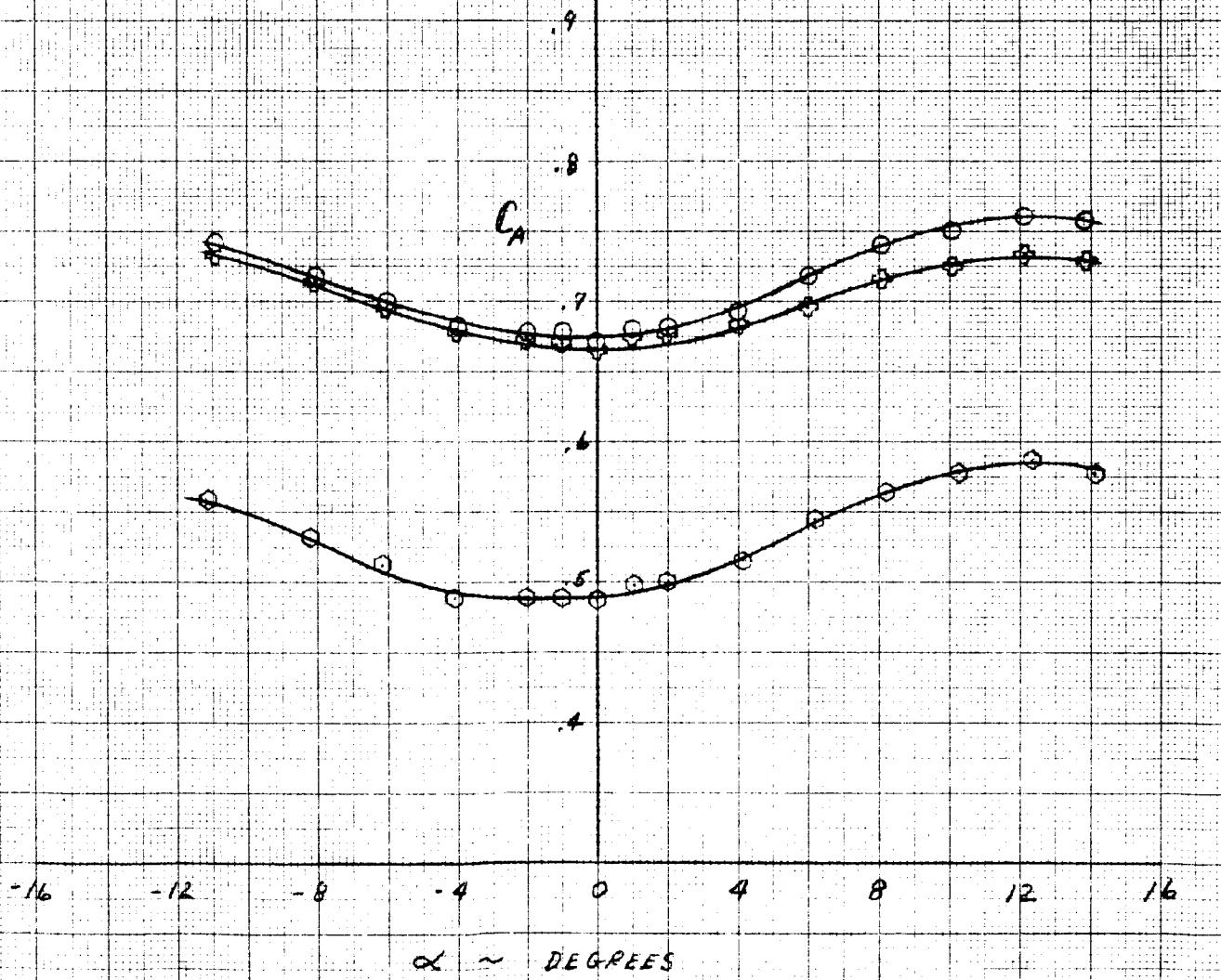
Model 12  
19 February 1963

LITTLE LAC II

Page 101  
Report No. G-63-465  
Figure 91

EFFECT OF REACTION CONTROL FAIRINGS  
AND FINS ON LONGITUDINAL CHARACTERISTICS  
LANGLEY 8FT TRANSONIC PRESSURE TUNNEL  
WASHER OFF MACH NO = 1.20

REACTION CONTROL FAIRINGS      FINS  
RUN 1      ON      0°  
RUN 3      OFF      0°  
RUN 10      OFF      OFF  
(RN =  $3.23 \times 10^6$  PER FOOT)



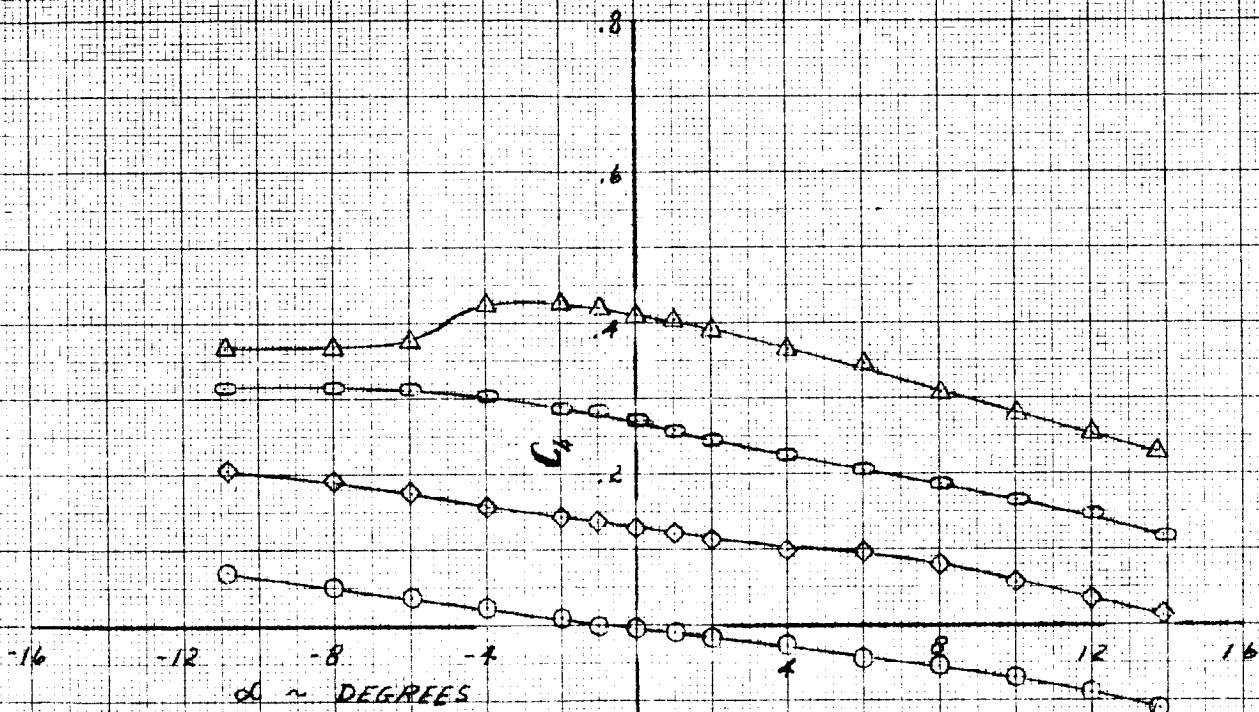
Model 12  
Date 19 Feb. 1963

LITTLE JOE II  
HINGE MOMENT CHARACTERISTICS  
LANGLEY 8FT TRANSONIC PRESSURE TUNNEL  
WASHER OFF  
MACH NO = 0.30

FIGURE 98

○ RUN 1  $S_{1,2,3,4}$  =  $0^\circ$   
○ RUN 4  $S_{1,2,3,4}$  =  $-10^\circ$   
○ RUN 6  $S_{1,2,3,4}$  =  $-20^\circ$   
△ RUN 7  $S_{1,2,3,4}$  =  $-30^\circ$

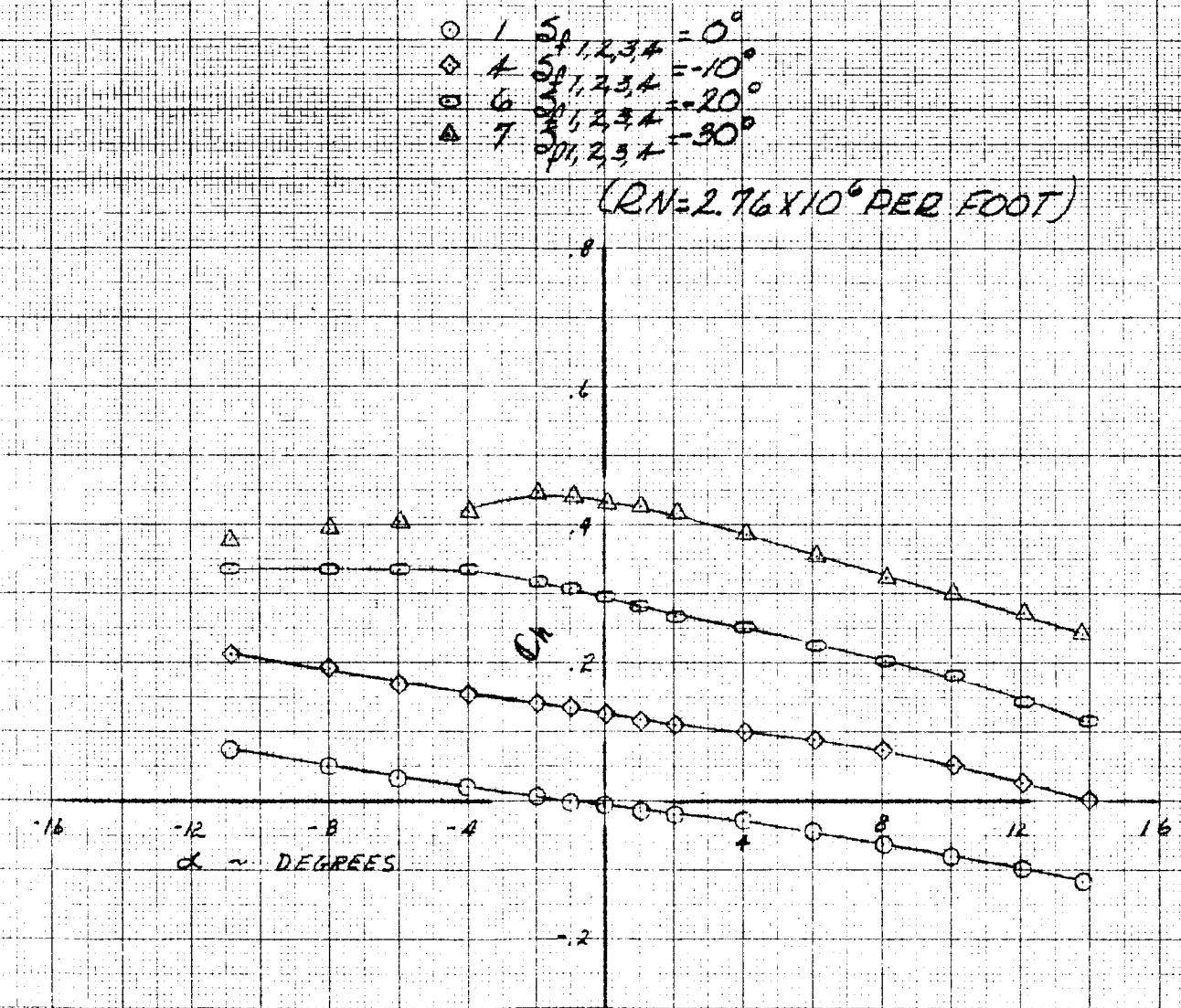
$(RN = 1.8 \times 10^6 \text{ PER FOOT})$

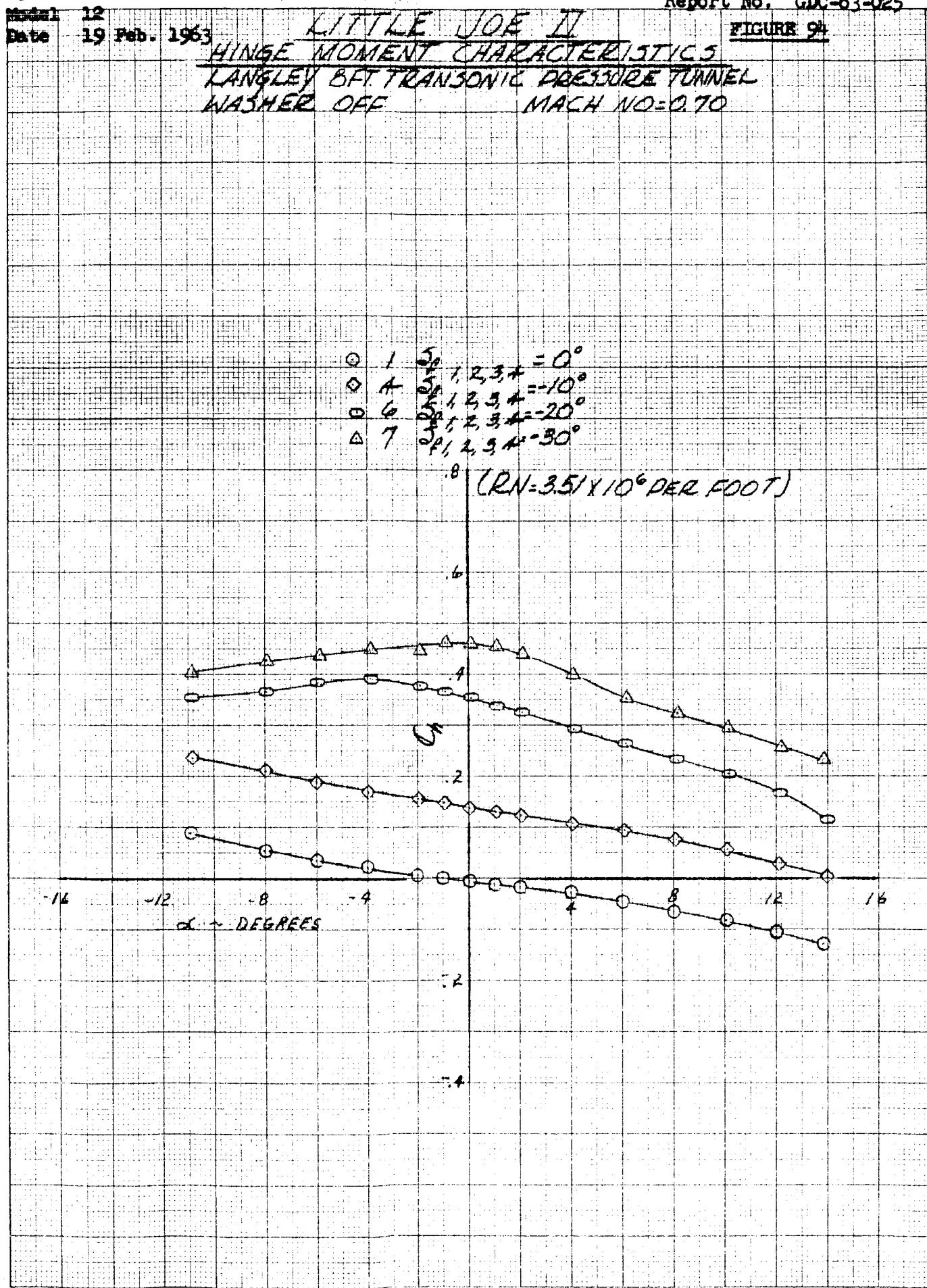


Date 19 February 1963

LITTLE JOE II  
HINGE MOMENT CHARACTERISTICSLANGLEY 8FT TRANSONIC PRESSURE TUNNEL  
WASHER OFF MACH NO = 0.50

FIGURE 93





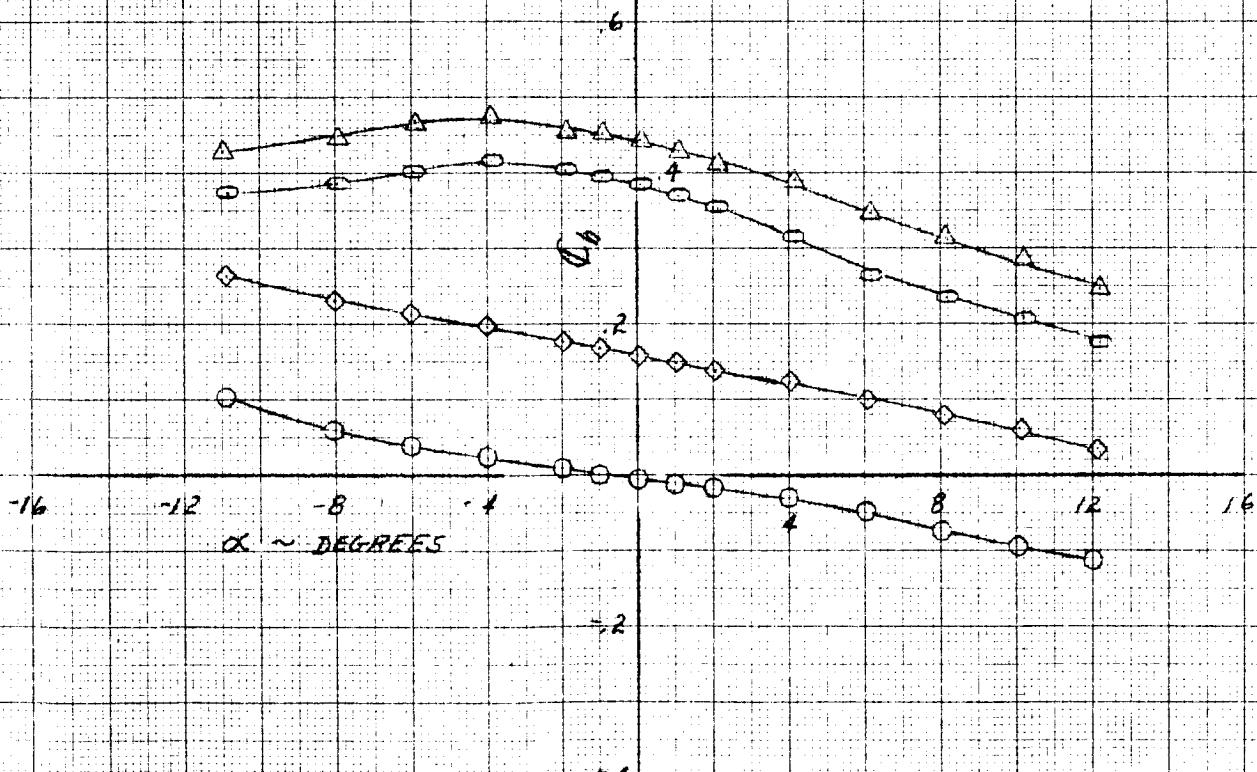
Model 12

Date 19 Feb. 1963

LITTLE JOE II  
 HINGE MOMENT CHARACTERISTICS  
 LANGLEY 8 FT. TRANSONIC PRESSURE TUNNEL  
 WASHER OFF MACH NO=0.80

FIGURE 92

$$\begin{array}{l} \textcircled{0} \ 1 \ 5^{\circ} \\ \textcircled{0} \ 4 \ 5^{\circ} \\ \textcircled{0} \ 6 \ 5^{\circ} \\ \textcircled{0} \ 7 \ 5^{\circ} \end{array} \begin{array}{l} 1, 2, 3, 4 \\ -10^{\circ} \\ -20^{\circ} \\ -30^{\circ} \end{array}$$

(RN =  $3.77 \times 10^6$  PER FOOT)

Model 12  
Date 19 Feb. 1963

LITTLE JOE II  
HINGE MOMENT CHARACTERISTICS  
LANGLEY BFT TRANSONIC PRESSURE TUNNEL  
WASHER OFF MACH NO = 0.90

FIGURE 36

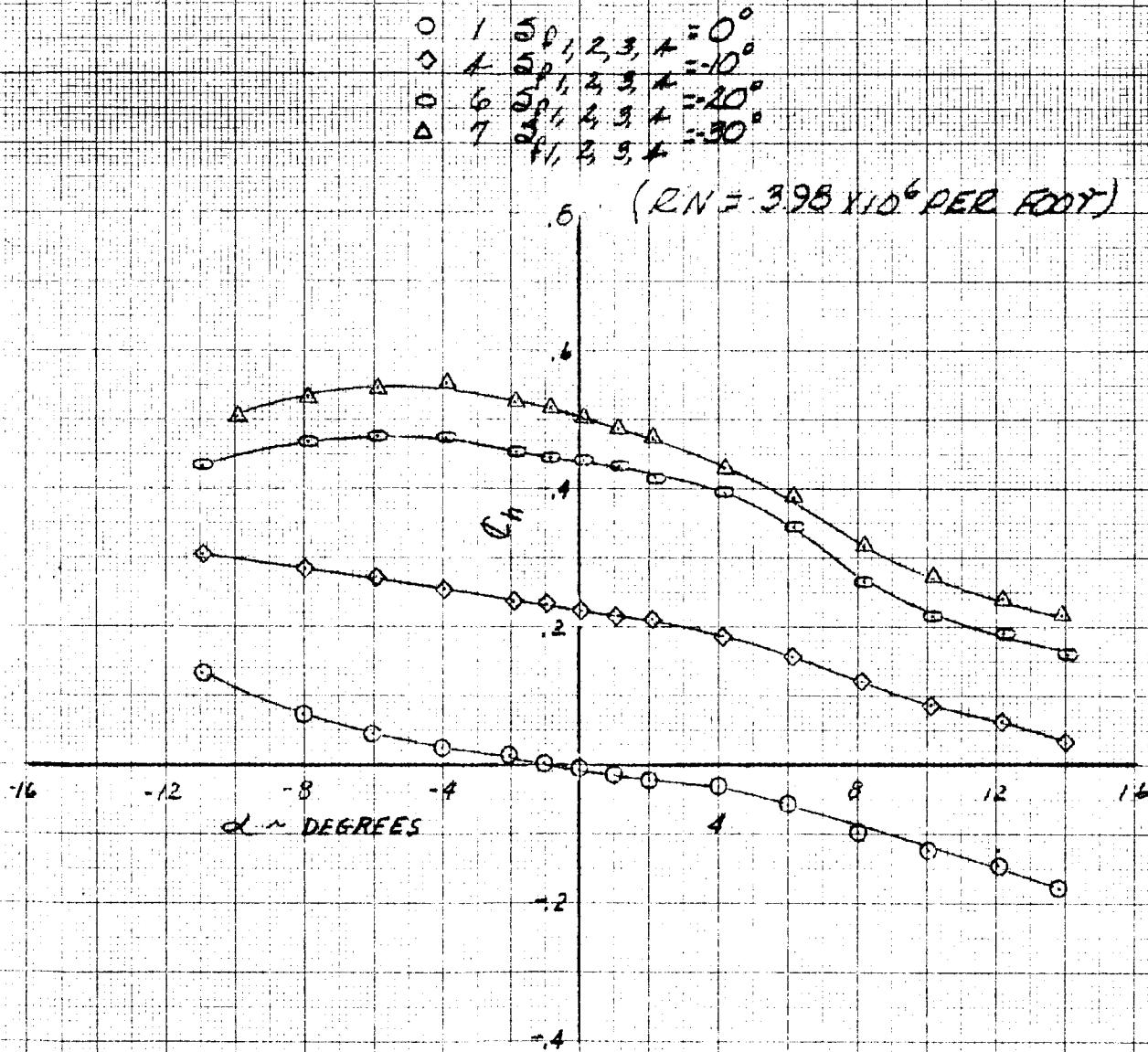
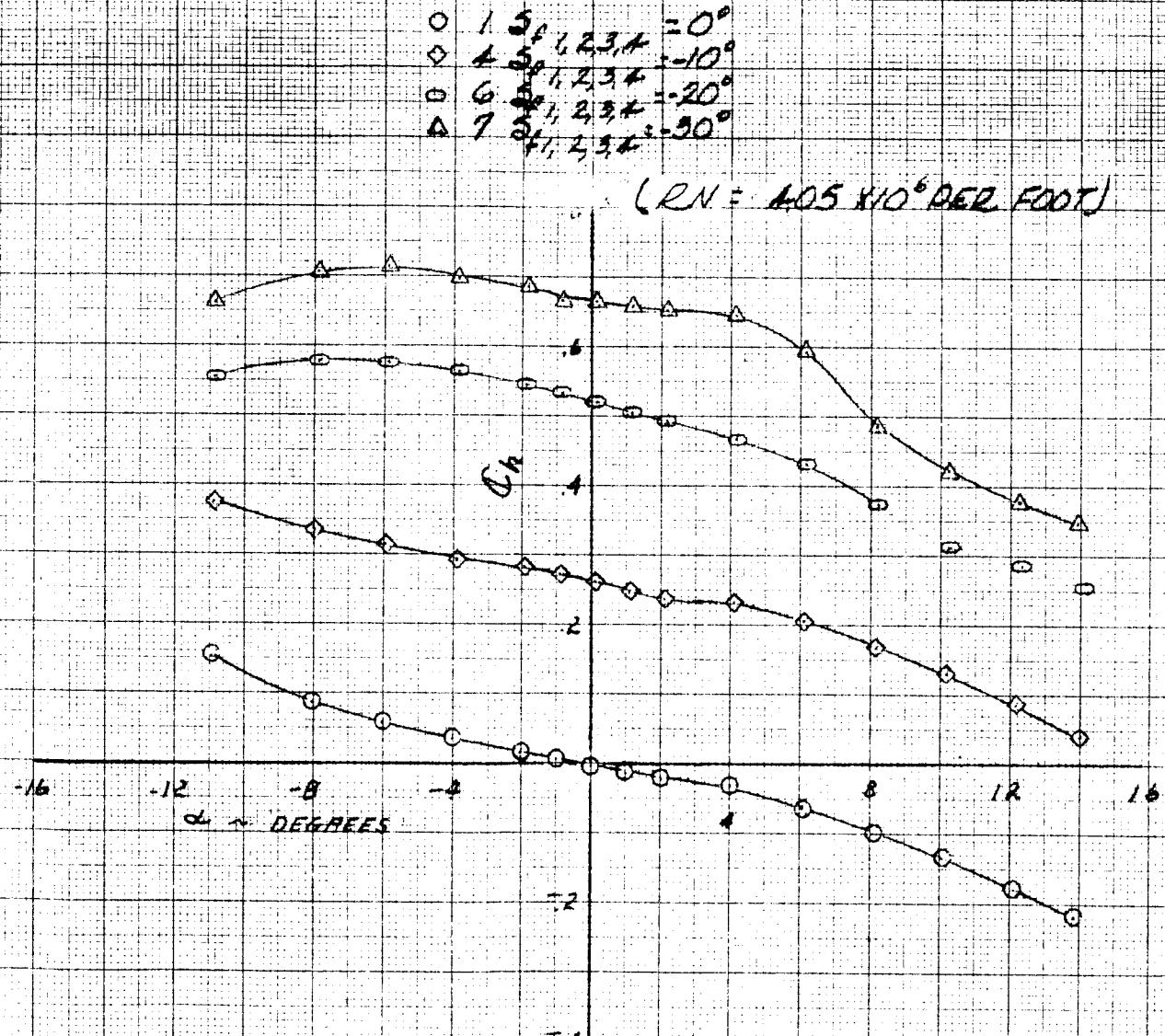


FIGURE 91

Model 12  
Date 19 Feb. 1963

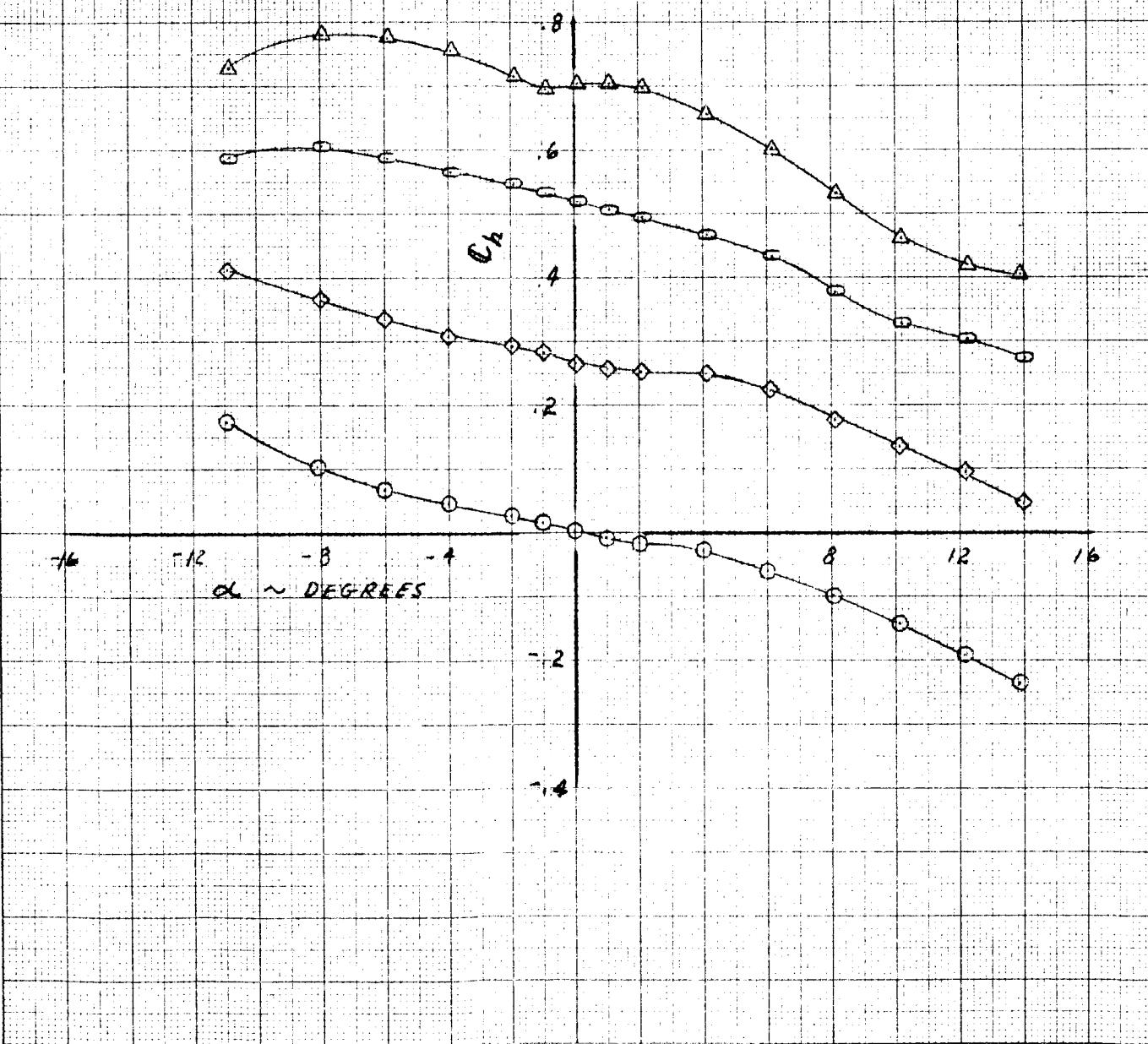
LITTLE JOE II  
HINGE MOMENT CHARACTERISTICS  
LANGLEY 8FT. TRANSONIC PRESSURE TUNNEL  
WASHER OFF  
MACH NO=0.95



**FIGURE 98**Model 12  
Date 19 Feb. 1963

**LITTLE WIDE YI**  
**HINGE MOMENT CHARACTERISTICS**  
**LANGLEY 6FT TRANSONIC PRESSURE TUNNEL**  
**WASHER OFF**      **MACH NO=1.00**

$\circ 1 \quad S_{1,2,3,4} = 0^\circ$   
 $\diamond 4 \quad S_{1,2,3,4} = -10^\circ$   
 $\square 6 \quad S_{1,2,3,4} = -20^\circ$   
 $\Delta 7 \quad S_{1,2,3,4} = -30^\circ$

(RN = 3.20/10<sup>6</sup> PER FOOT)

Model 12

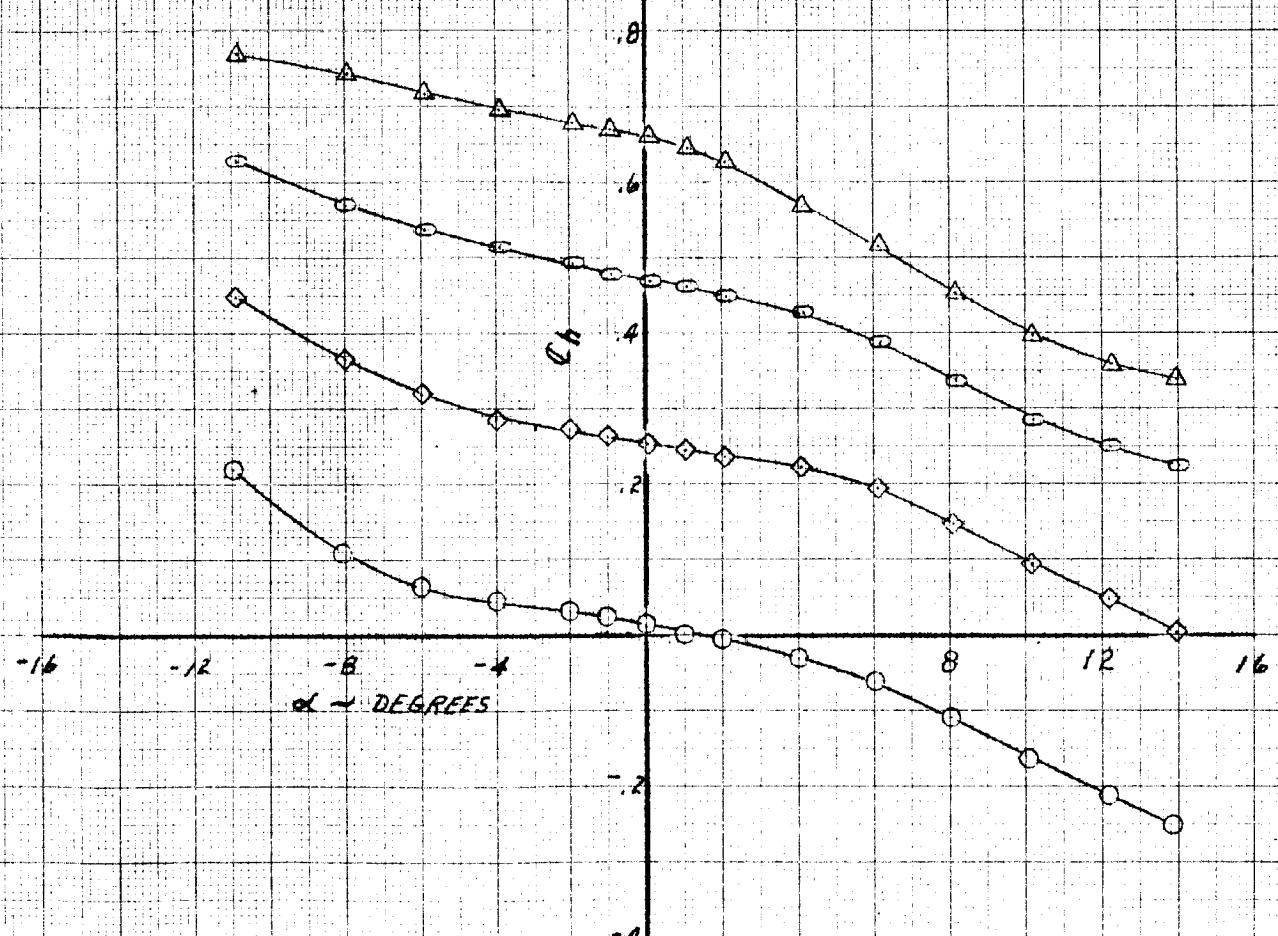
Date 19 Feb. 1963

LITTLE JOE II  
HINGE MOMENT CHARACTERISTICS  
LANGLEY BFT TRANSONIC PRESSURE TUNNEL  
WARMER OFF  
MACH NO=1.20

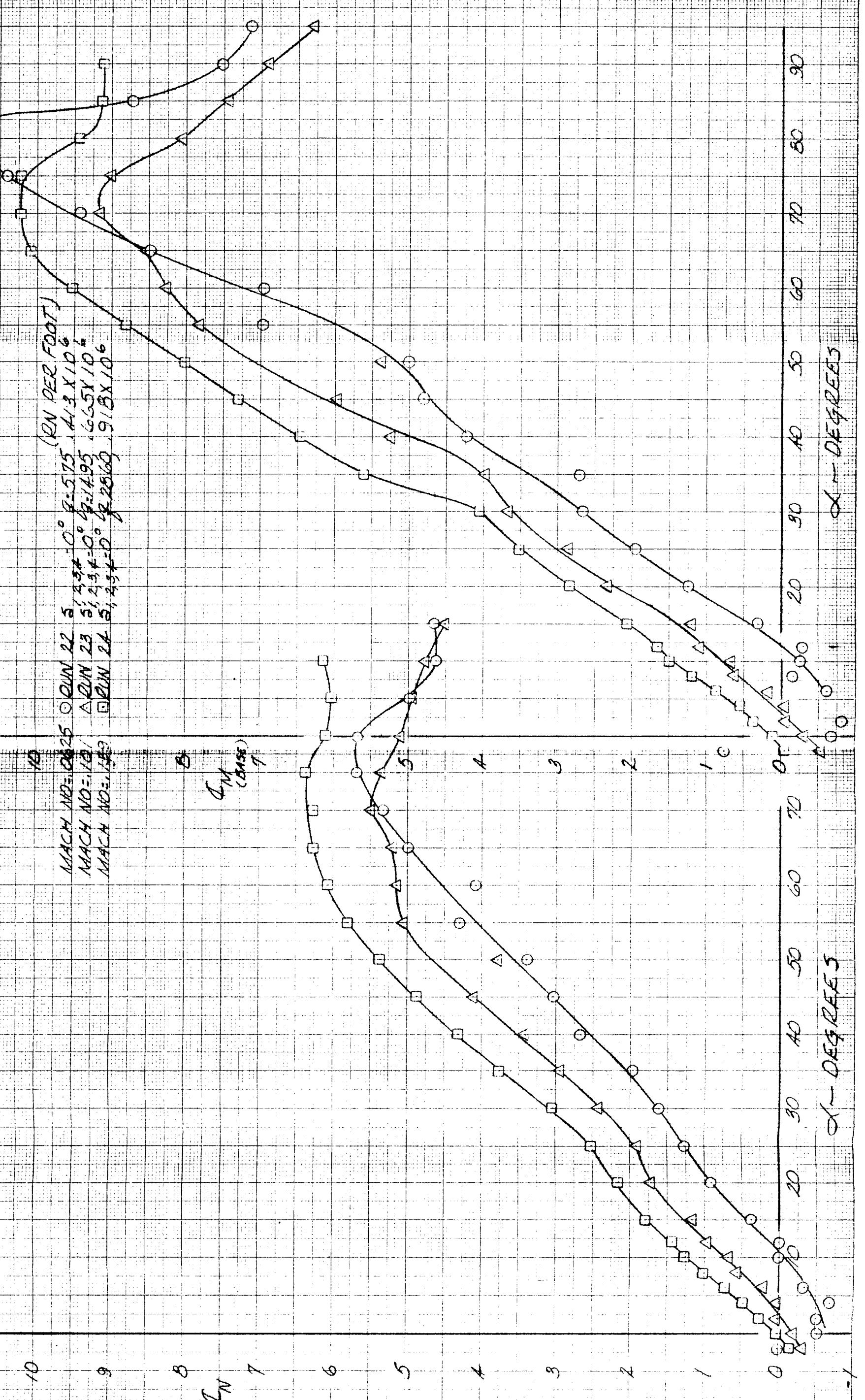
FIGURE 99

○ 1  $\delta_f = 0^\circ$   
 ◇ 4  $\delta_f = -10^\circ$   
 □ 6  $\delta_f = -20^\circ$   
 △ 7  $\delta_f = -30^\circ$

( $R_N = 3.28 \times 10^6$  PER FOOT)



EFFECT OF DRYING AND COOKING ON THE CHARACTERISTICS  
OF THE COTTON FIBER



Model 122

19 February 1963

EFFECT OF "g" ON LONGITUDINAL CHARACTERISTICS  
TYPICAL LOAD SPORED CHANNEL  
TOWER ON WASHED OUT

(EM DEC EAST)

○ D/W 22 5<sup>1/2</sup> 3<sup>1/2</sup> = 0° E = 575 N = 10<sup>6</sup> M/S = 10<sup>6</sup>  
△ D/W 23 5<sup>1/2</sup> 3<sup>1/2</sup> = 0° E = 1495 N = 665 X 10<sup>6</sup> M/S = 10<sup>6</sup>  
□ D/W 24 5<sup>1/2</sup> 3<sup>1/2</sup> = 0° E = 2860 N = 918 X 10<sup>6</sup> M/S = 10<sup>6</sup>

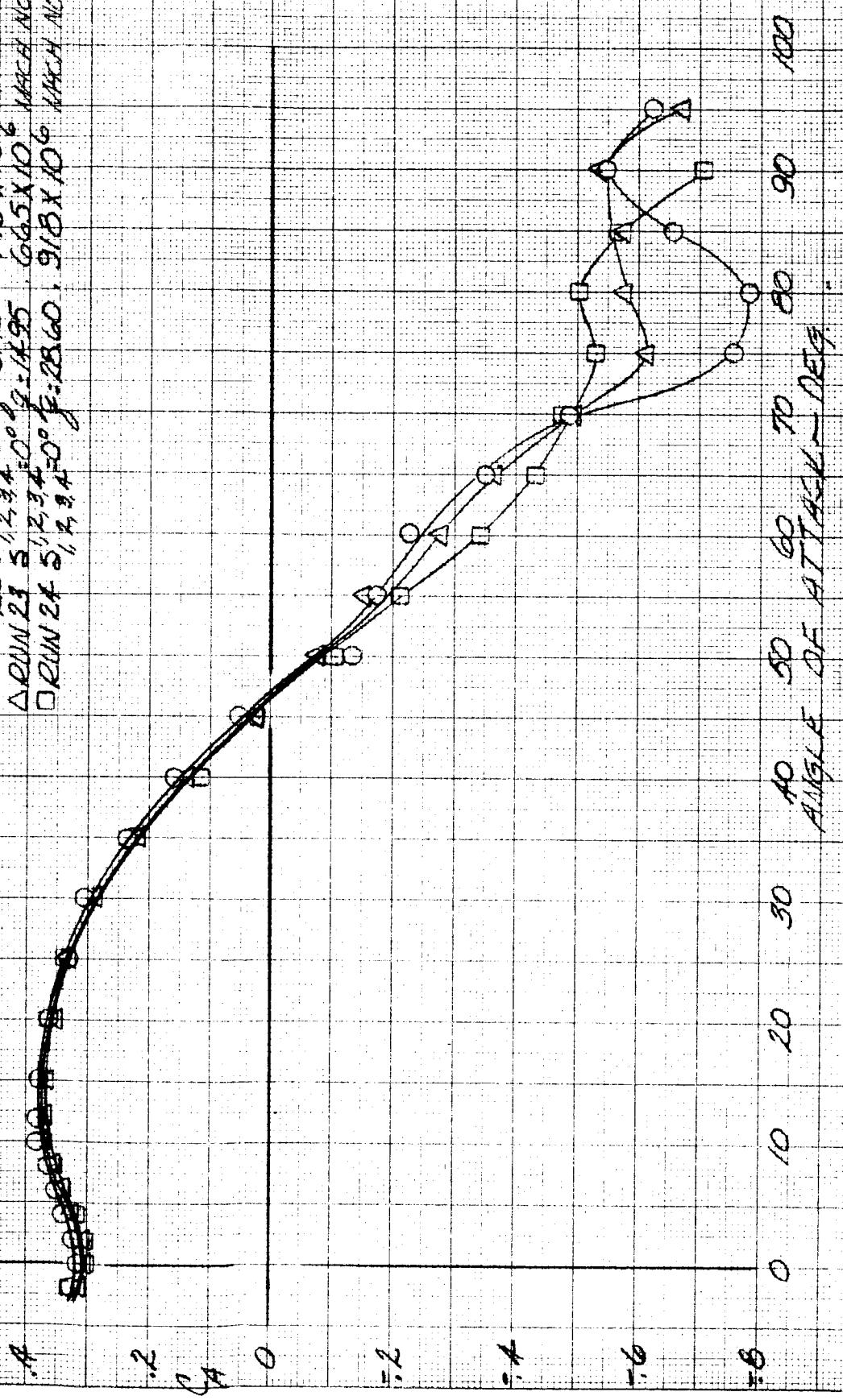
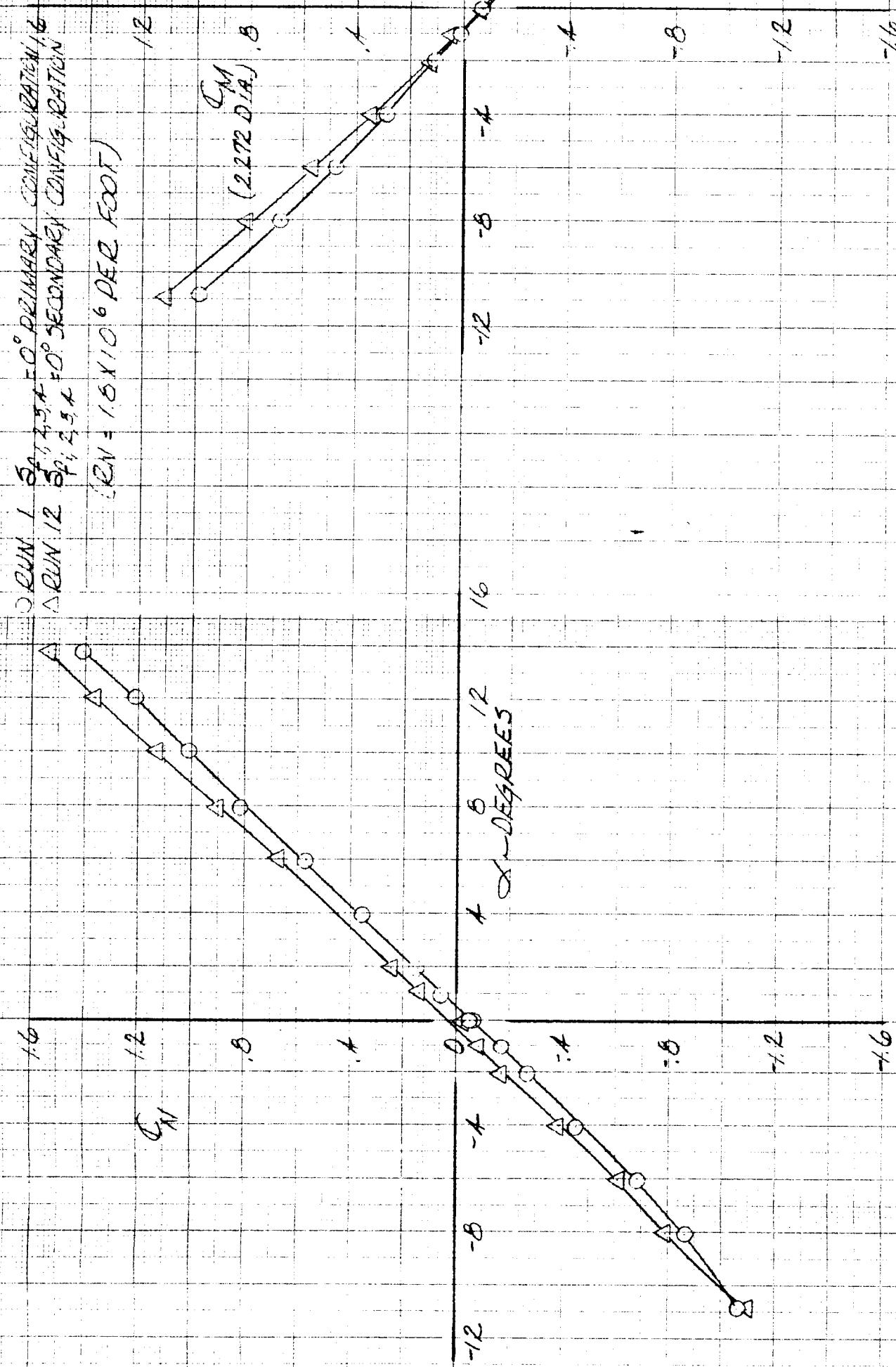


FIGURE 102

COMPARISON OF PRIMARY CONFIGURATION  
W/ 74 SECONDARY CONFIGURATION  
ANGLE SET TO INSONIC PRESSURE TUNNEL  
WASHER OFF MACH NO = 0.30

COLUMN 1 5°, 2.5°, -5° PRIMARY CONFIGURATION,  
COLUMN 12 5°, 2.5°, +5° SECONDARY CONFIGURATION

$$CR = 1.8 \times 10^6 \text{ DEG FOOT}$$



COMPARISON OF PRIMARY CONFIGURATION  
WITH SECONDARY CONFIGURATION  
LANGLEY 8FT TRANSONIC PRESSURE TUNNEL  
WASHER OFF MACH NO=0.30

○ RUN 1  $\delta_1, 2, 3, 4 = 0^\circ$  PRIMARY CONFIGURATION  
△ RUN 12  $\delta_1, 2, 3, 4 = 0^\circ$  SECONDARY CONFIGURATION  
(RN =  $1.8 \times 10^{-6}$  PER FOOT)

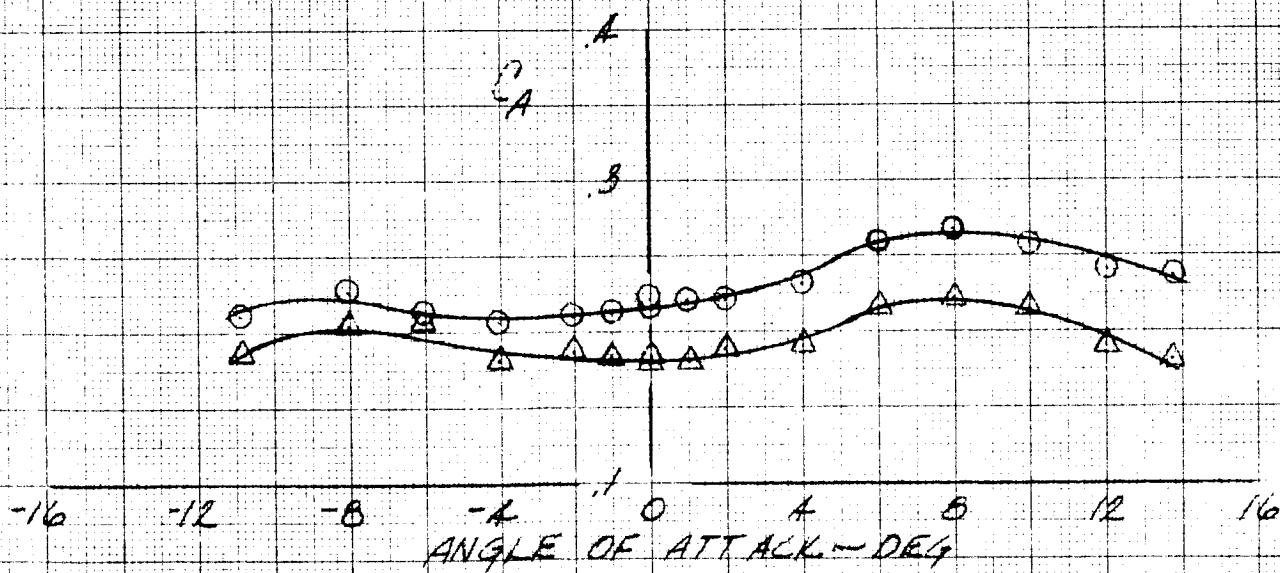
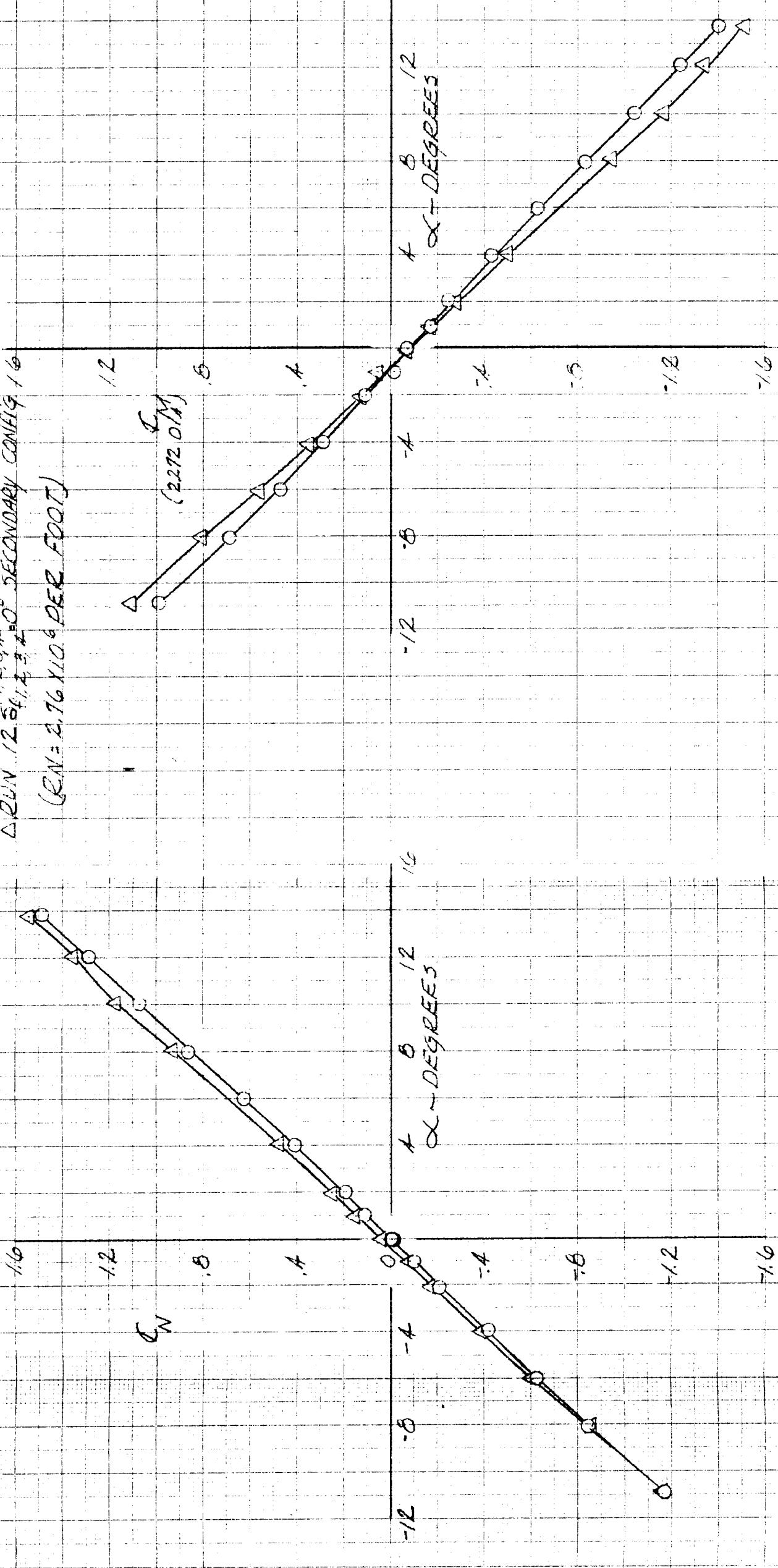


FIGURE 104

COMPARISON OF PRIMARY CONFIGURATION  
WITH SECONDARY CONFIGURATION  
LANGLEY SET TRANSonic PRESSURE SURFACE  
WASHER OFF  
MACH NO = 0.50

0 RUN / 5°, 2.94°, 0° PRIMARY CONFIG  
△ RUN / 2.54°, 2.2°, 0° SECONDARY CONFIG / 6  
(CN = 2.76 X 10<sup>3</sup> PER FOOT)



Model 12  
19 February 1963

LITTLE JOE II

Page

115

Report No.

GDC-63-025

Figure 105

COMPARISON OF PRIMARY CONFIGURATION  
WITH SECONDARY CONFIGURATION  
LANGLEY 8FT TRANSONIC PRESSURE TUNNEL  
WASHER OFF MACH NO = 0.50

O RUN 1  $\delta_{1,2,3,4} = 0^\circ$  PRIMARY CONFIGURATION  
△ RUN 12  $\delta_{1,2,3,4} = 0^\circ$  SECONDARY CONFIGURATION  
(RN =  $2.76 \times 10^6$  PER FOOT)

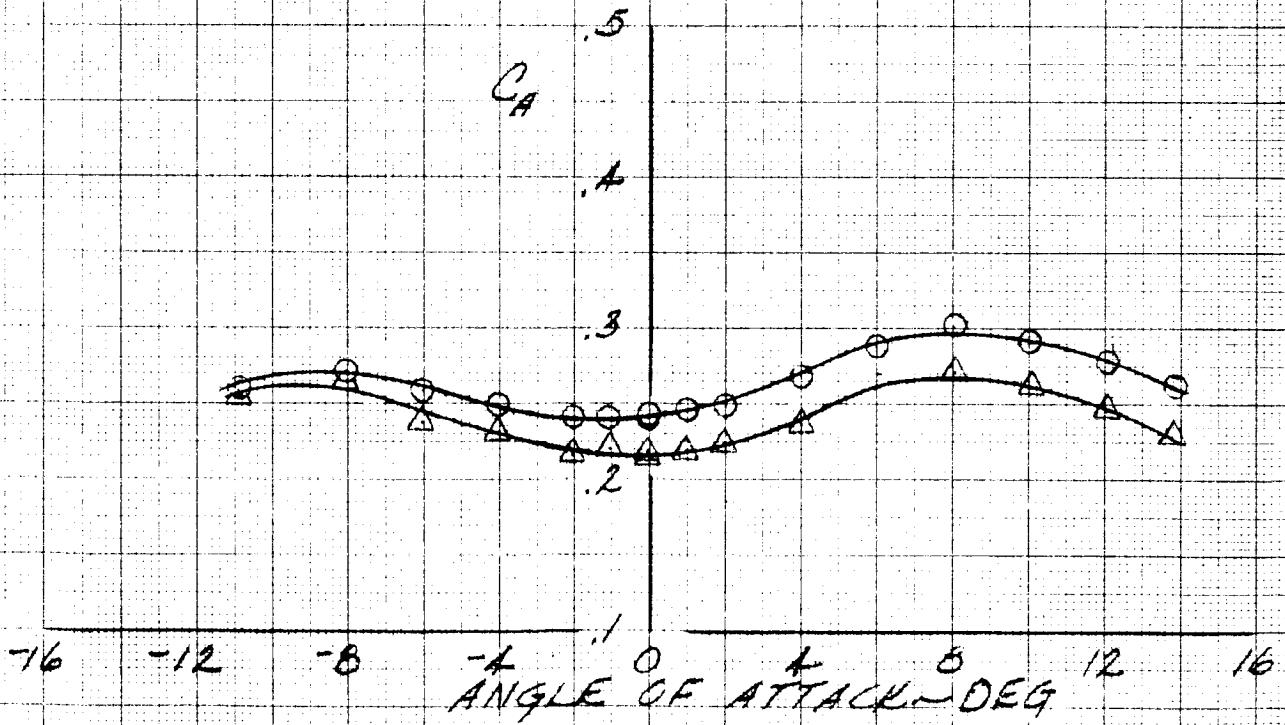
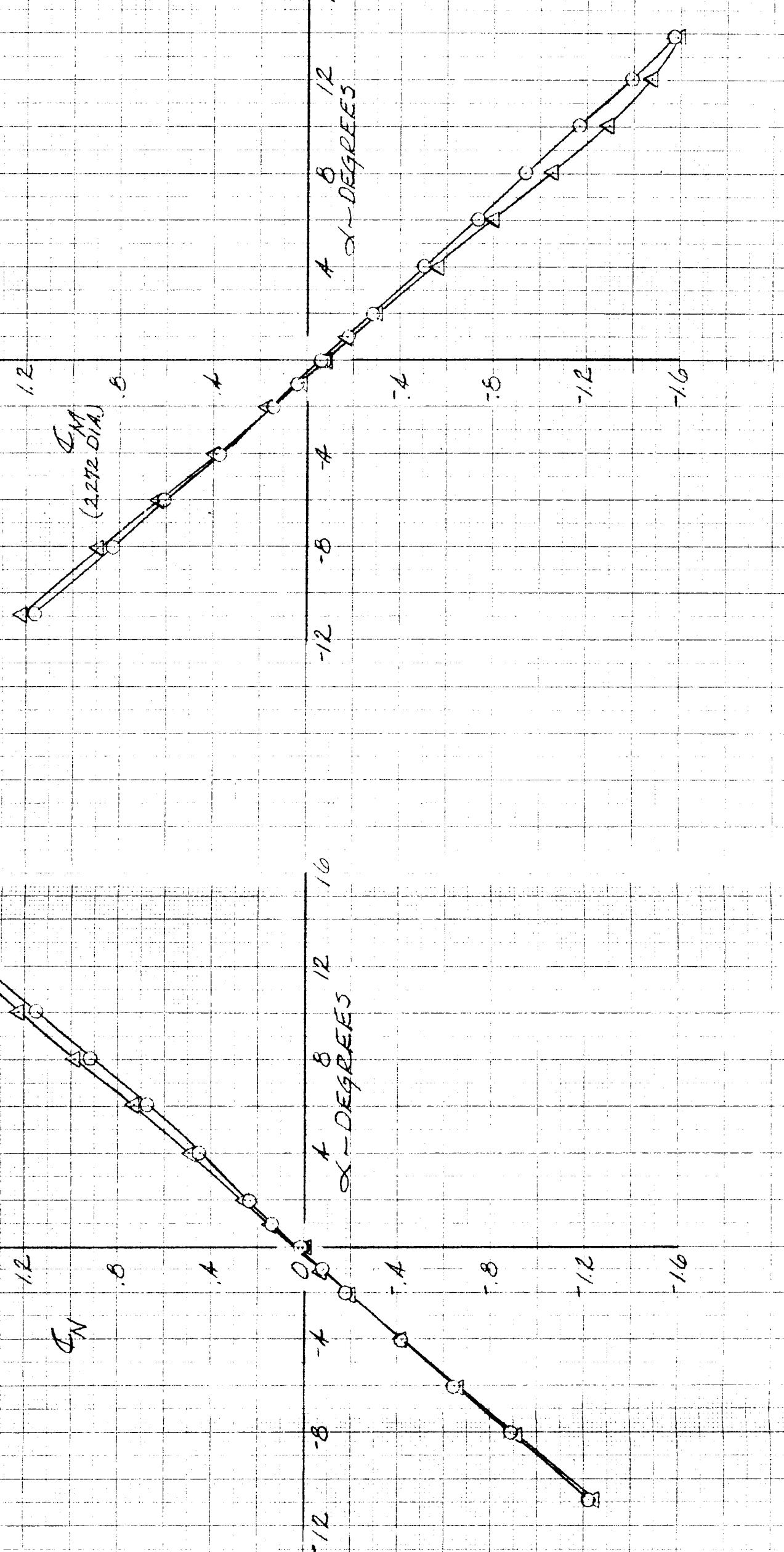


FIGURE 106

CONF 1501 LITTLE JOE II  
WITH PRIMARY CONFIGURATION  
LANGLEY TRANSONIC DEPRESSURE TUNNEL  
WASHER OFF  
MACH NO.: 0.70

RUN 1 25° 12° 3° 4°  
RUN 12 50° 12° 3° 4°  
SECONDARY CONFIG.  
(EN = 3.51 X 10<sup>6</sup> PER FOOT)



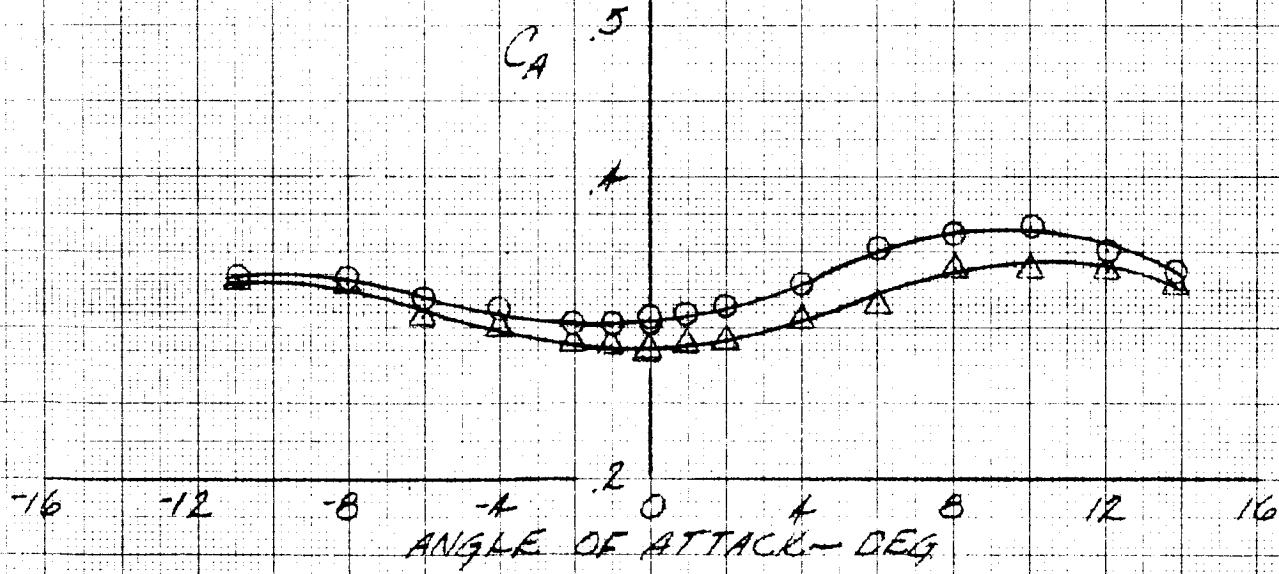
Model 12  
19 February 1963

LITTLE JOE II

Page 117  
Report No. GDC-63-025  
Figure 107

COMPARISON OF PRIMARY CONFIGURATION  
WITH SECONDARY CONFIGURATION  
LANGLEY 8FT TRANSONIC PRESSURE TUNNEL  
WASHER OFF MACH NO = 0.70

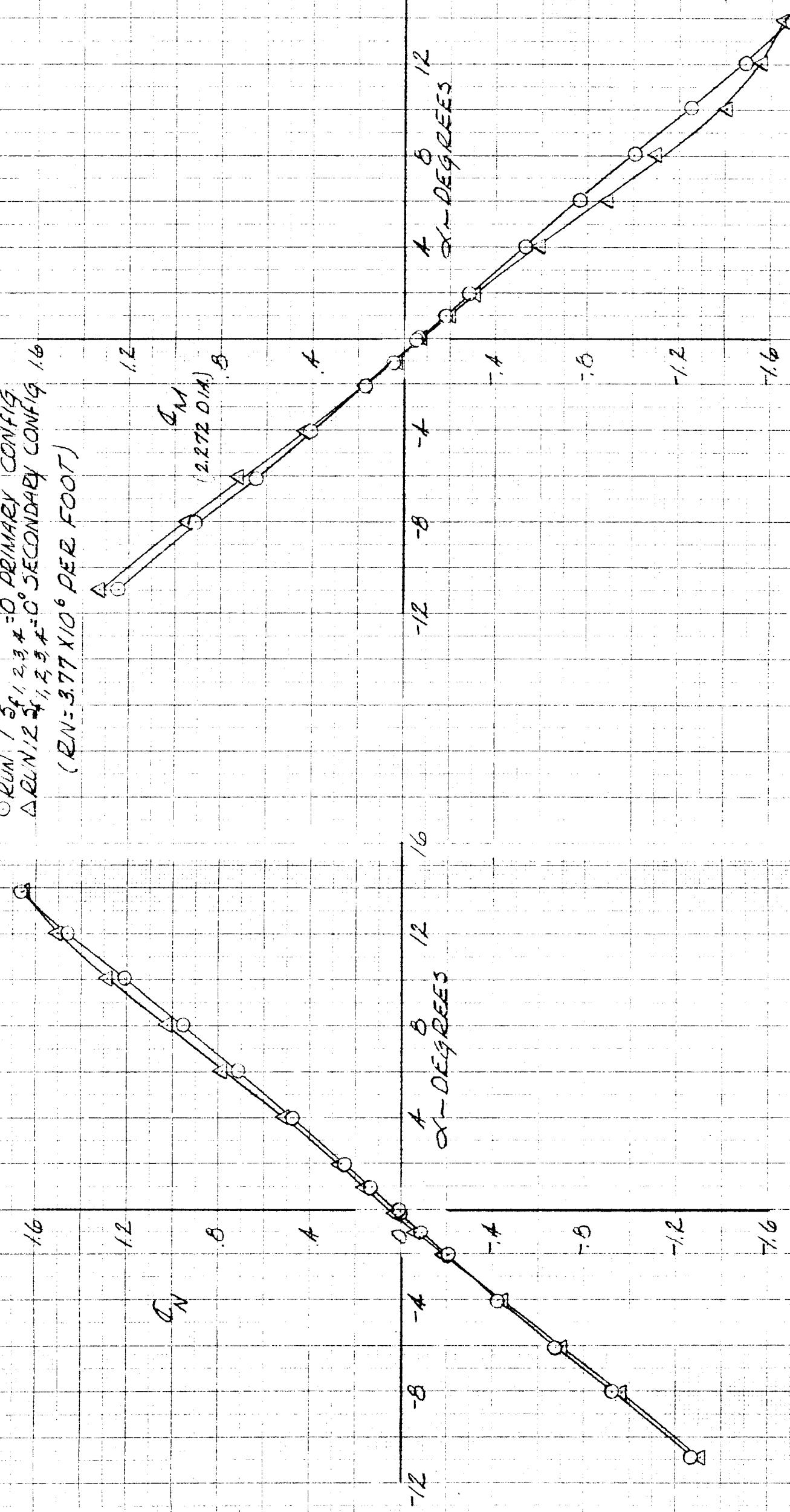
O RUN 1  $\delta_{1,2,3,4} = 0^\circ$  PRIMARY CONFIGURATION  
△ RUN 12  $\delta_{1,2,3,4} = 0^\circ$  SECONDARY CONFIGURATION  
(RN =  $3.51 \times 10^6$  PER FOOT)



L1774 USE IT  
COMPARISON OF PRIMARY CONFIGURATION  
WITH SECONDARY CONFIGURATION  
LANGLEY SET 2 INSONIC PRESSURE TUNNEL  
WASHED OFF

FIGURE 108

RUN 1 5°, 2.3 ± 0° PRIMARY CONFIG.  
ΔCN/2 2.3 ± 0° SECONDARY CONFIG. 1.6  
( $R_N = 3.77 \times 10^6$  PER FOOT)



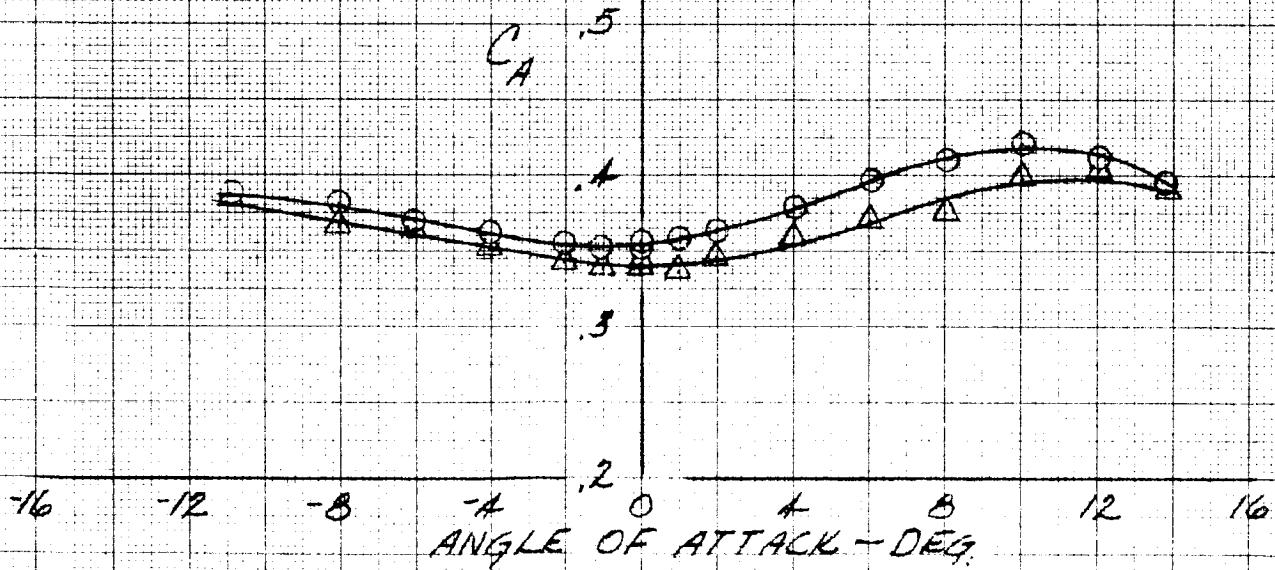
Model 12  
19 February 1963

LITTLE JOE II

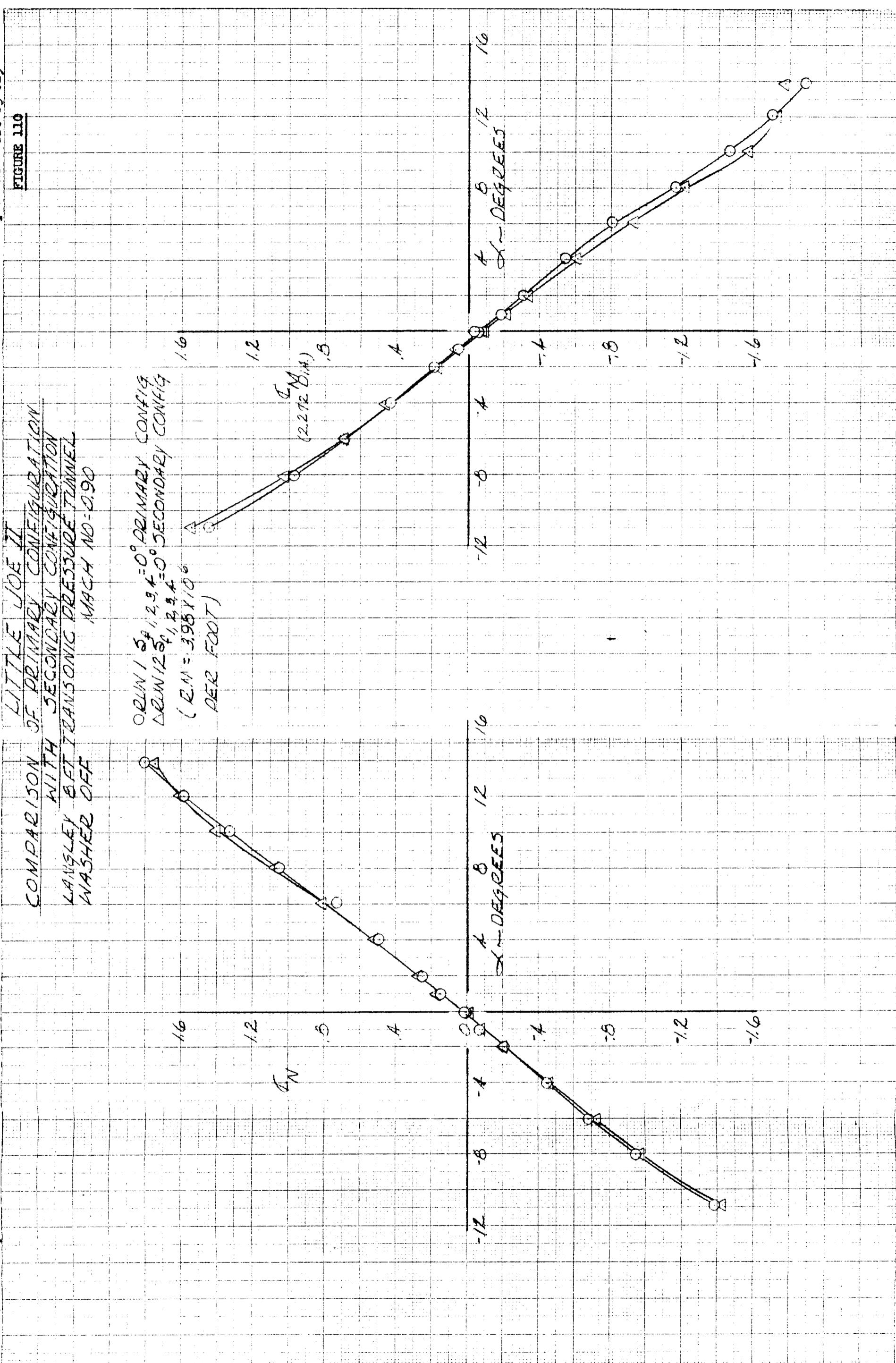
Page 119  
Report No. GDO-63-025  
Figure 109

COMPARISON OF PRIMARY CONFIGURATION  
WITH SECONDARY CONFIGURATION  
LANGLEY 8 FT TRANSONIC PRESSURE TUNNEL  
WASHER OFF MACH NO: 0.80

O RUN 1 S<sub>1,2,3,4</sub> = 0° PRIMARY CONFIGURATION  
△ RUN 12 S<sub>1,2,3,4</sub> = 0° SECONDARY CONFIGURATION  
(R<sub>A</sub> = 3.77 X 10<sup>6</sup> PER FOOT)



**FIGURE 110**



Model 12  
19 February 1963

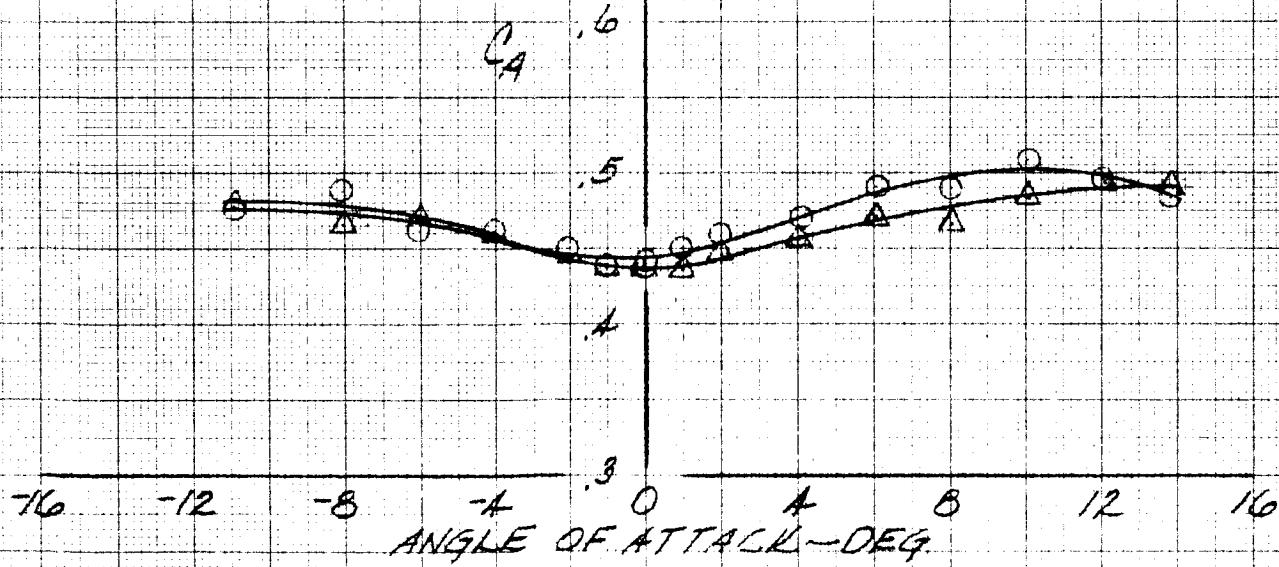
LITTLE JOE II

Page 121  
Report No. GDC-63-025  
Figure 111

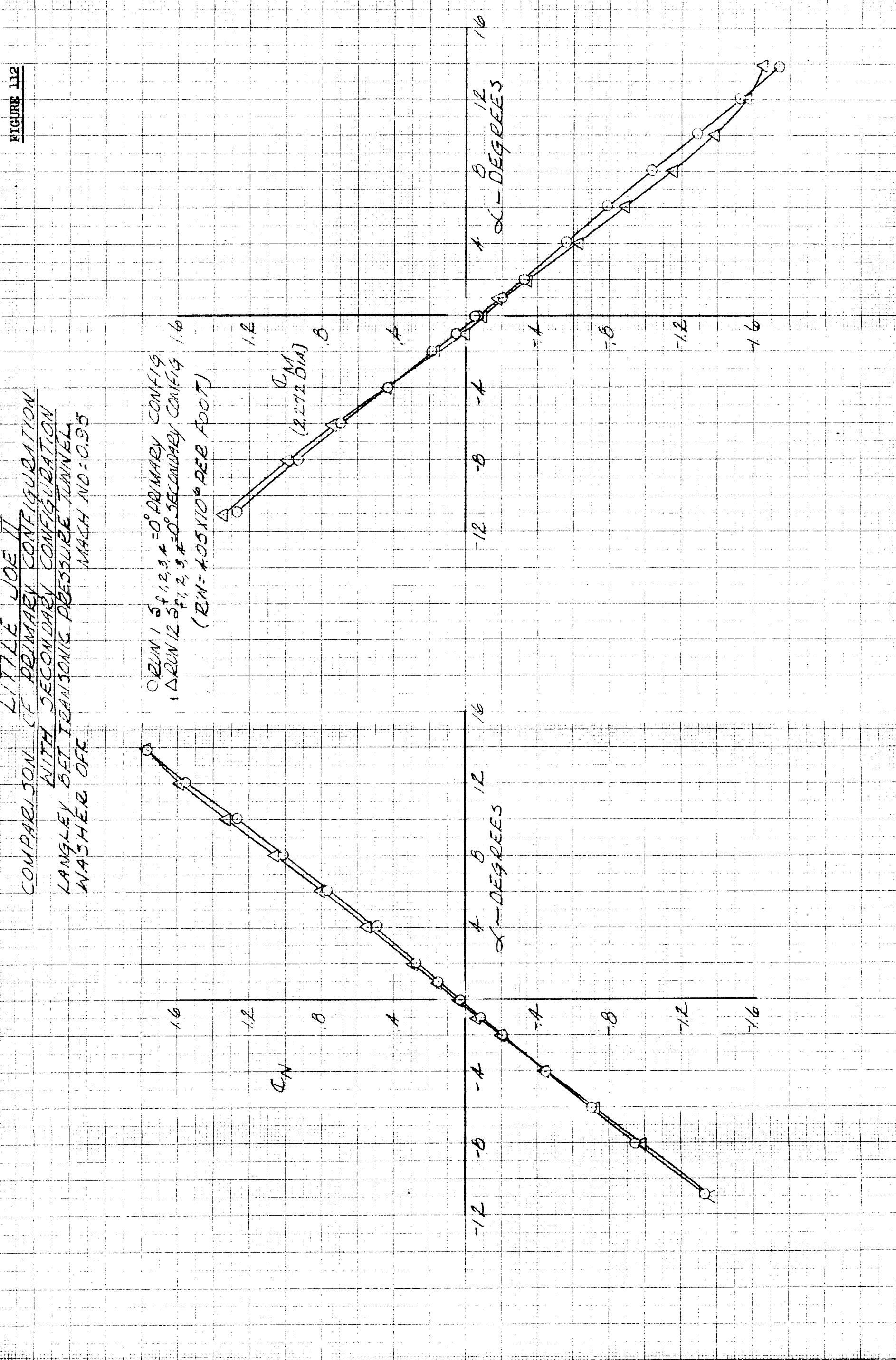
COMPARISON OF PRIMARY CONFIGURATION  
WITH SECONDARY CONFIGURATION

LANGLEY 8FT. TRANSONIC PRESSURE TUNNEL  
WASHER OFF MACH NO = 0.90

ORUN 1  $\delta_{f,1,2,3,4} = 0^\circ$  PRIMARY CONFIGURATION  
ORUN 12  $\delta_{f,1,2,3,4} = 0^\circ$  SECONDARY CONFIGURATION  
( $R.N. = 3.98 \times 10^6$  PER FOOT)



LITTLE JOE  
PRIMARY CONFIGURATION  
WITH SECONDARY CONFIGURATION  
LANGLEY SET TEASONIC PRESSURE TUNNEL  
MACH NO = 0.95



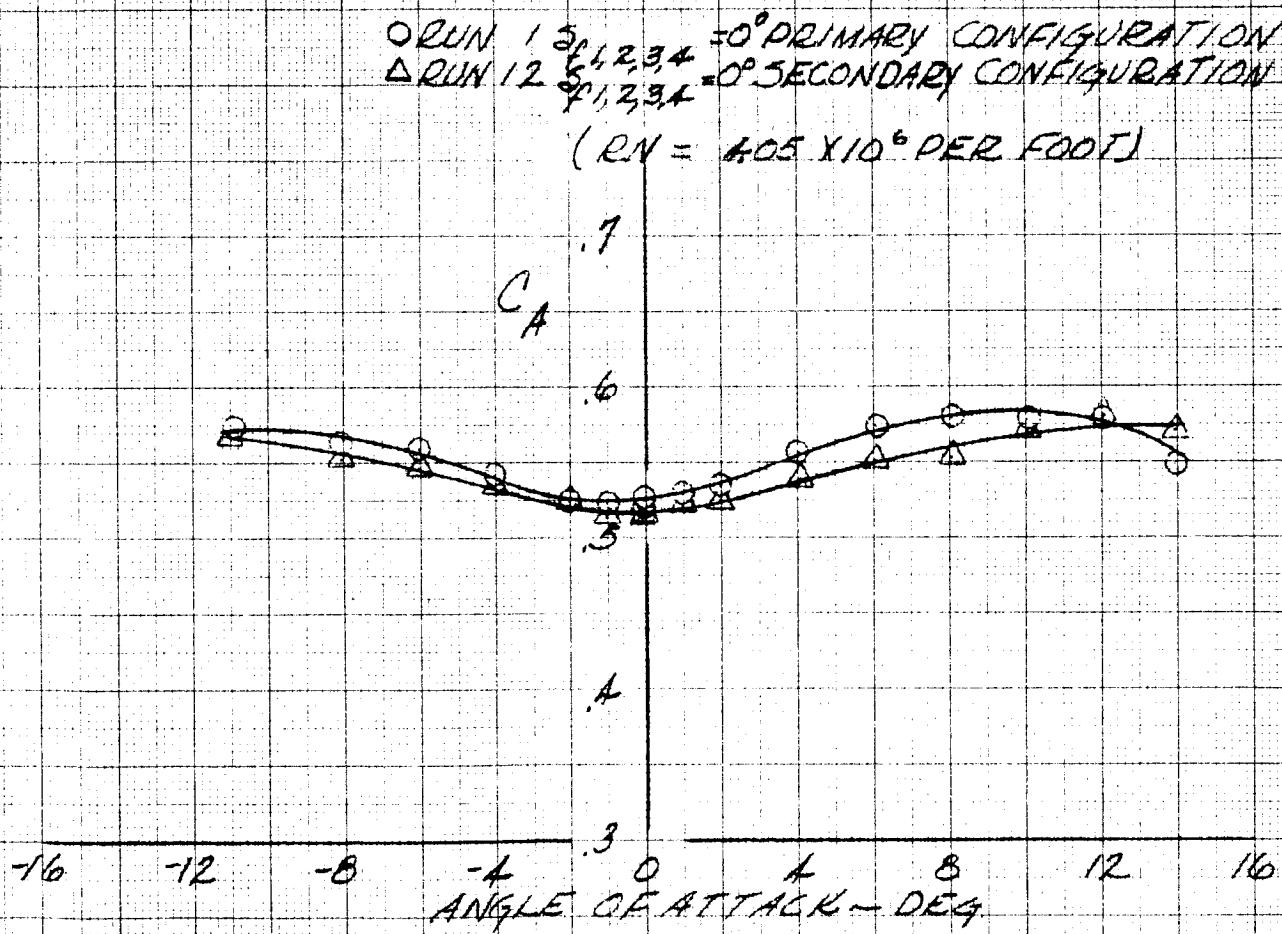
Model 12  
19 February 1963

# LITTLE JOE II

Page 123  
Report No. GDC-63-025  
Figure 113

## COMPARISON OF PRIMARY CONFIGURATION WITH SECONDARY CONFIGURATION

LANGLEY 6FT TRANSONIC PRESSURE TUNNEL  
WASHER OFF MACH NO = 0.95

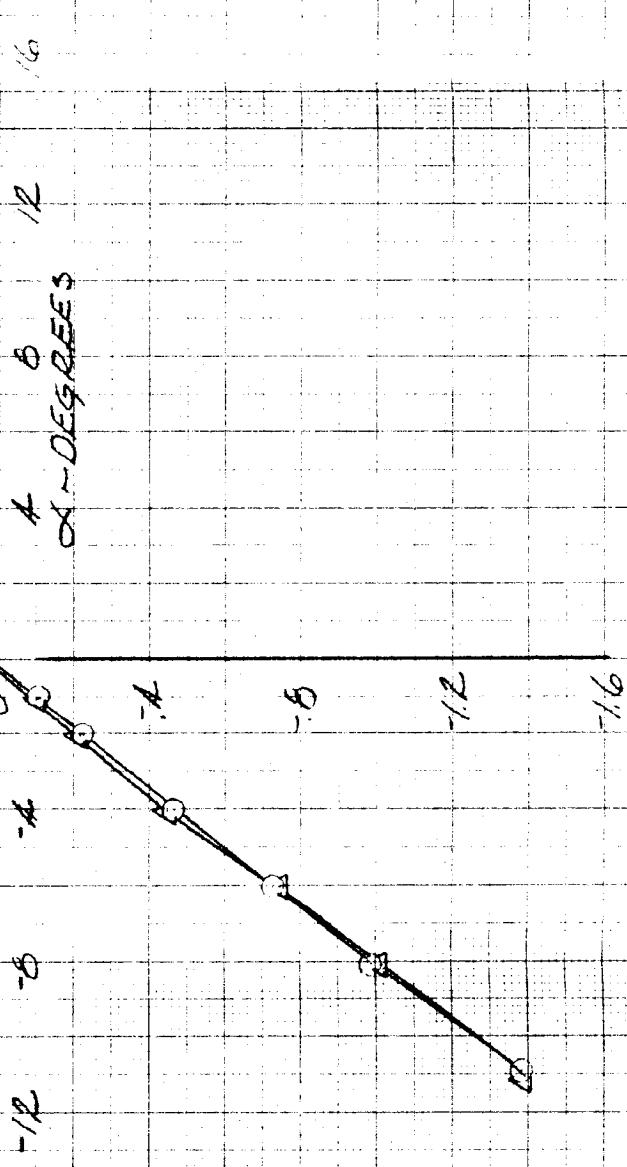
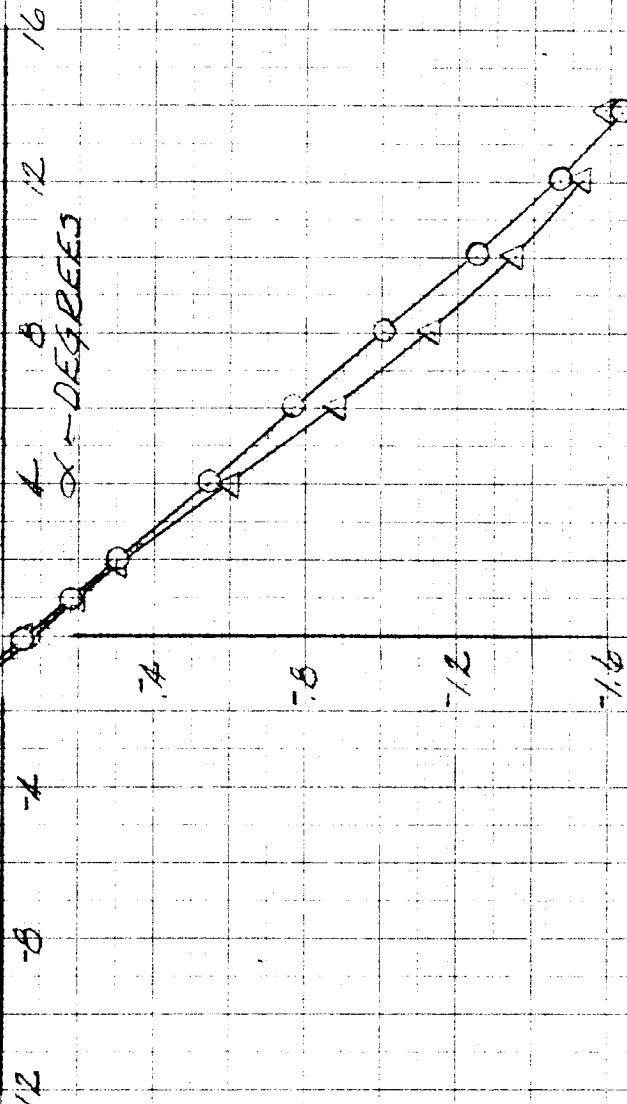


LITTLE JOE II  
COMPRESSOR WITH TRANSonic PRESCOUR TUNNEL  
LANGLEY WEAVER D54  
MACH NO = 100

OPEN 1 5 ft 12.3 ft = 0° PRIMARY CONFIG.  
CLOSED 12 5 ft 12.3 ft = 0° SECONDARY CONFIG.  
(2 ft = 10<sup>6</sup> INCHES)

C<sub>M</sub>  
(2.272 DIA.)

1.2  
.6  
.4  
.2  
.0



COMPARISON OF PRIMARY CONFIGURATION  
WITH SECONDARY CONFIGURATION

LANGLEY 8FT TRANSONIC PRESSURE TUNNEL  
WASHER OFF MACH NO=1.00

△ RUN 1  $\delta_{1,2,3,4} = 0^\circ$  PRIMARY CONFIGURATION  
△ RUN 2  $\delta_{1,2,3,4} = 0^\circ$  SECONDARY CONFIGURATION  
( $R_N = 3.20 \times 10^6$  PER FOOT)

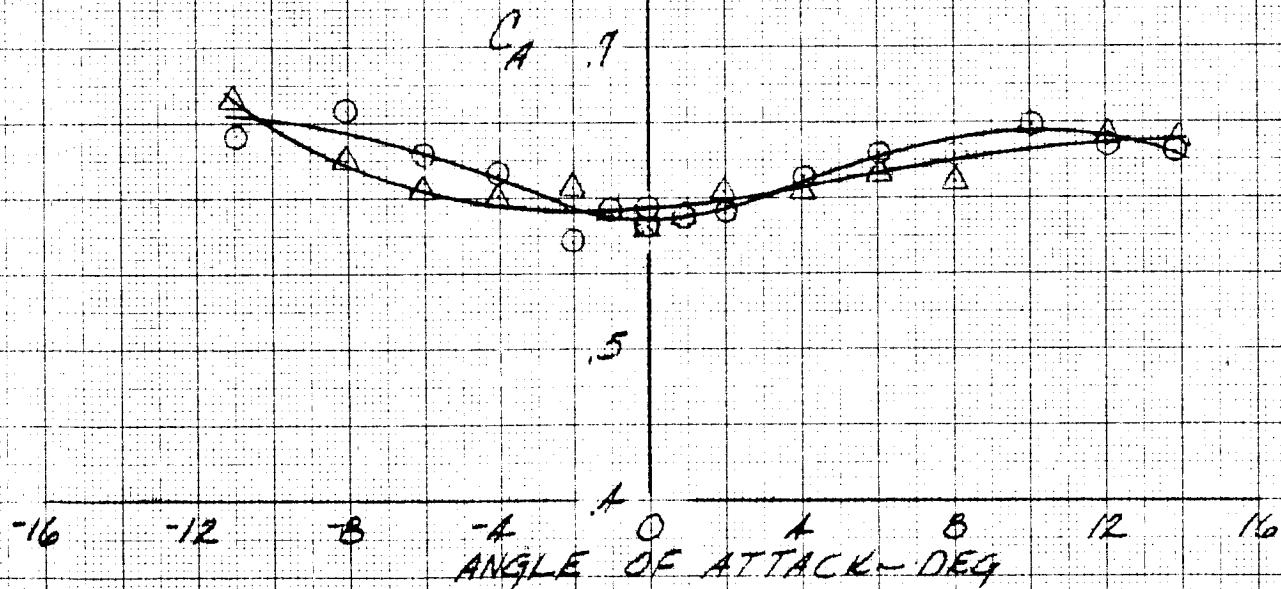
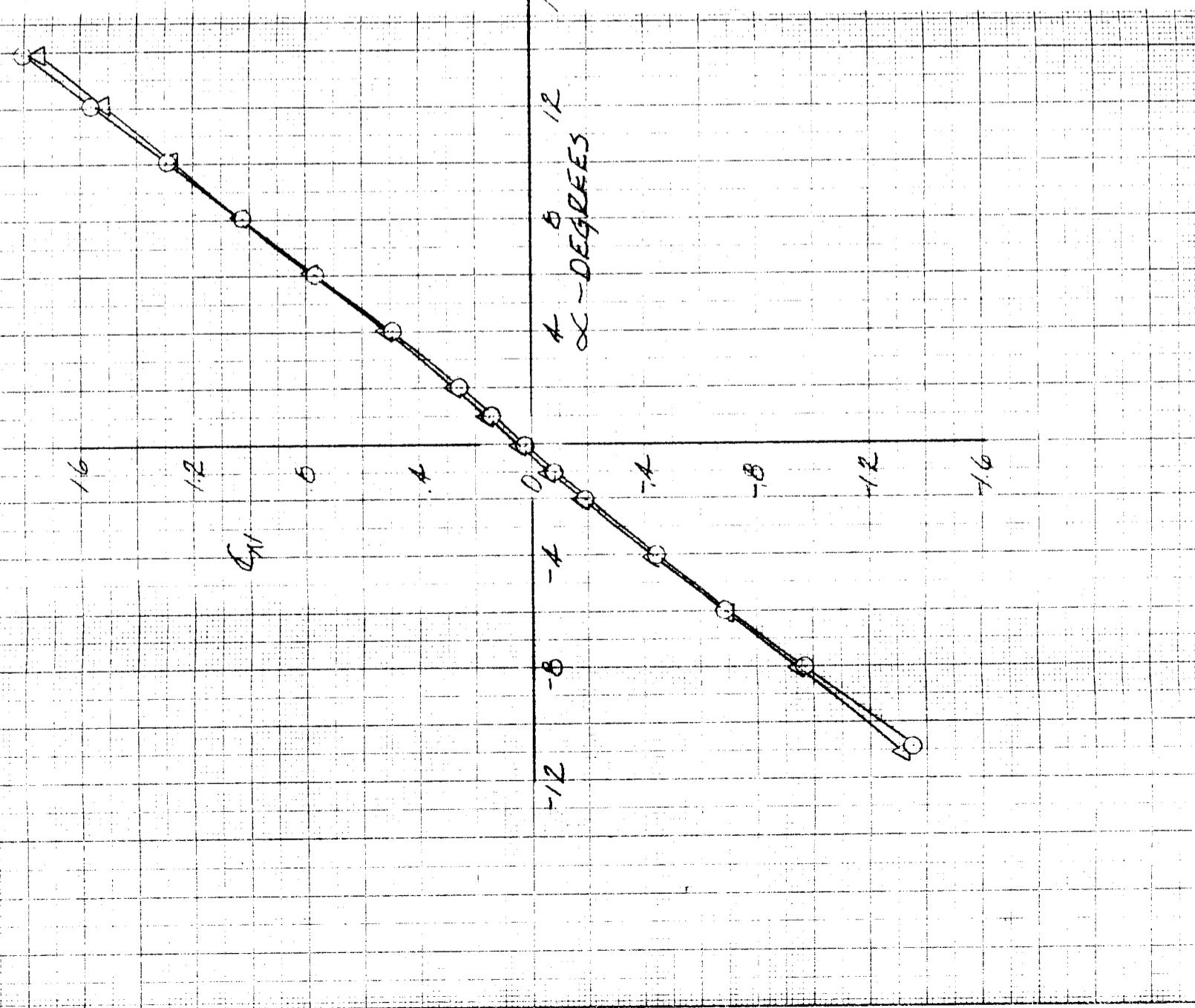


FIGURE 116

LITTLE JOE II  
COMPARISON OF PRIMARY CONFIGURATION  
WITH SECONDARY CONFIGURATION  
LANGLEY SET TRANSonic DRAWSHEET  
WASHED OUT  
MACH NO = 1.20

RUN 1 5ft 12° PRIMARY CONFIG  
△ RUN 12 2ft 23° & 10 SECONDARY CONFIG 1.6  
(2N = 1.28 1/10<sup>6</sup> DUE FOOT)



Model 12  
19 February 1963

LITTLE JOE II

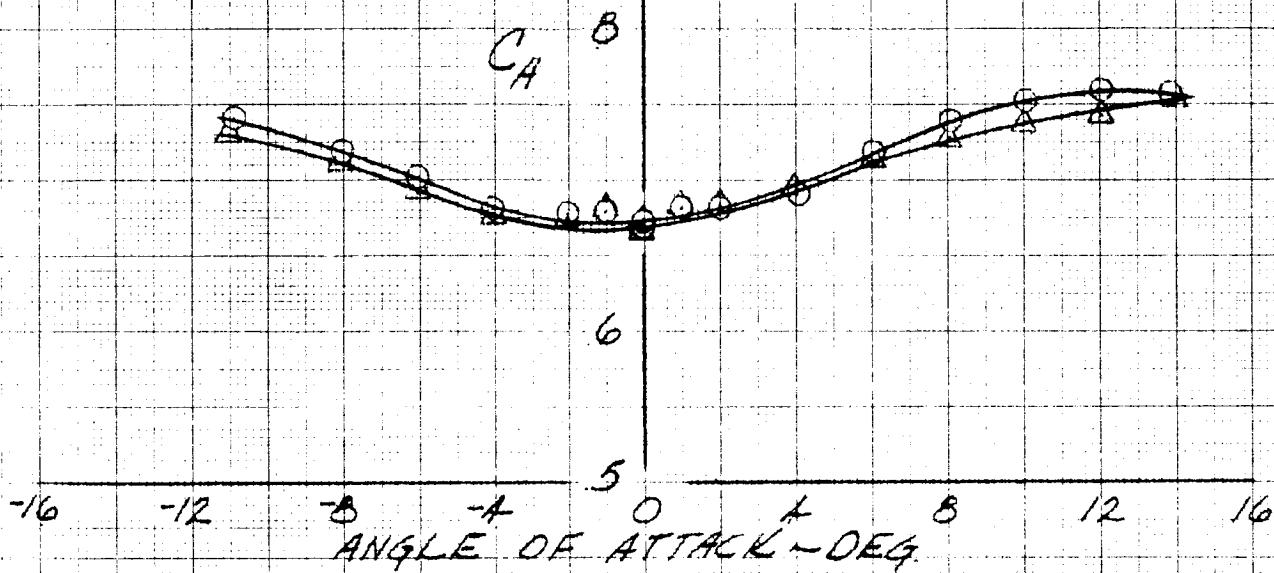
Page 127  
Report No. GDC-63-025  
Figure 117

COMPARISON OF PRIMARY CONFIGURATION  
WITH SECONDARY CONFIGURATION

LANGLEY BET TRANSONIC PRESSURE TUNNEL  
WASHER OFF MACH NO = 1.20

○ RUN 1  $\Sigma_{1,2,3,4}$  = 0° PRIMARY CONFIGURATION  
△ RUN 12  $\Sigma_{1,2,3,4}$  = 0° SECONDARY CONFIGURATION

(RN =  $3.28 \times 10^6$  PER FOOT)



Model 12  
19 February 1963

LITTLE JOE II

Page

128

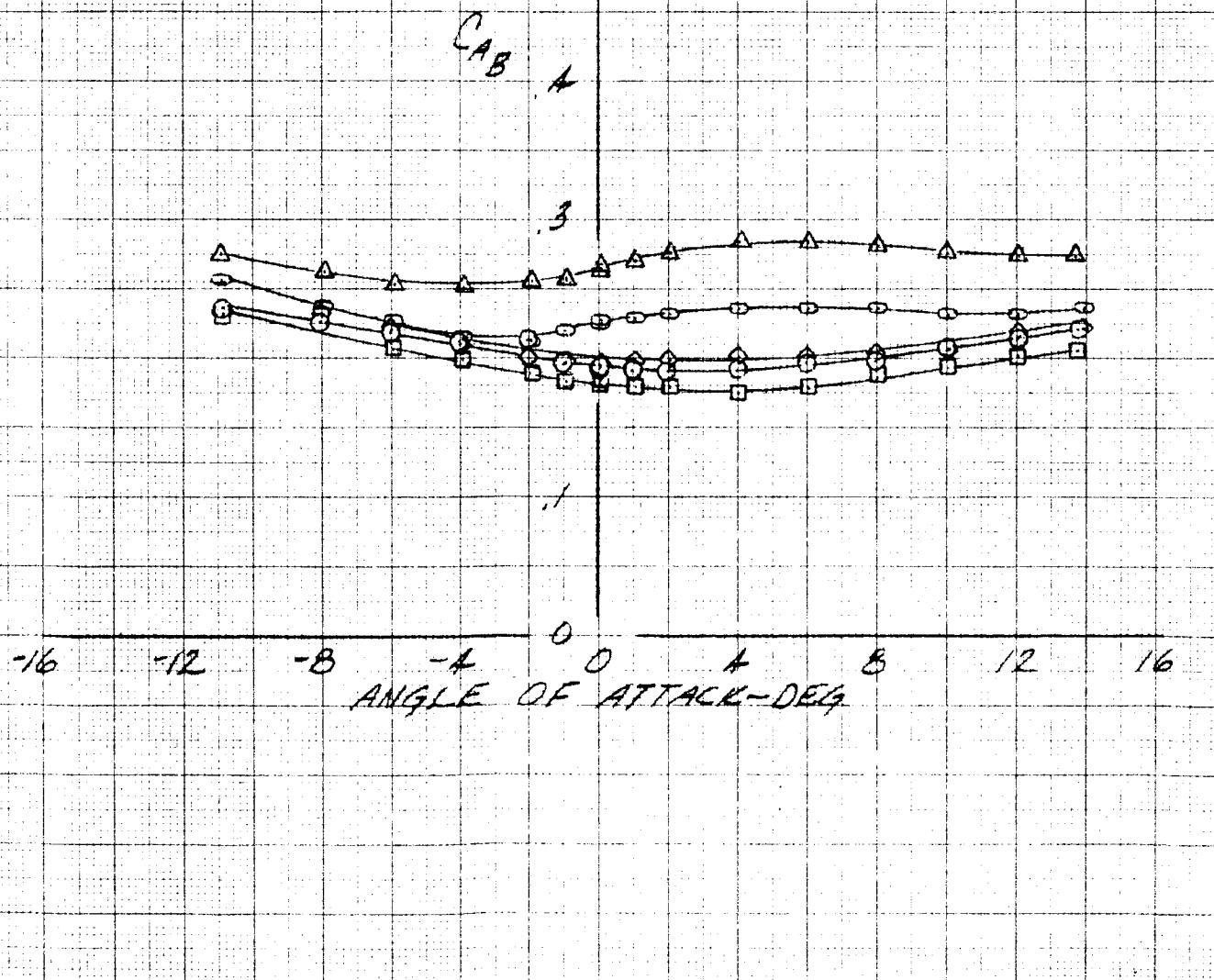
Report No. GDC-63-025

Figure 118

BASE DRAG CHARACTERISTICS  
LANGLEY 8 FT TRANSONIC PRESSURE TUNNEL  
WASHER OFF                           MACH NO = 0.30

(RN PER FOOT)

○ RUN 1 5<sub>1,2,3,4</sub> = 0°      1.8 × 10<sup>-6</sup>  
□ RUN 8 5<sub>1,2,3,4</sub> = -5°  
○ RUN 4 5<sub>1,2,3,4</sub> = -10°  
○ RUN 6 5<sub>1,2,3,4</sub> = -20°  
△ RUN 7 5<sub>1,2,3,4</sub> = -30°

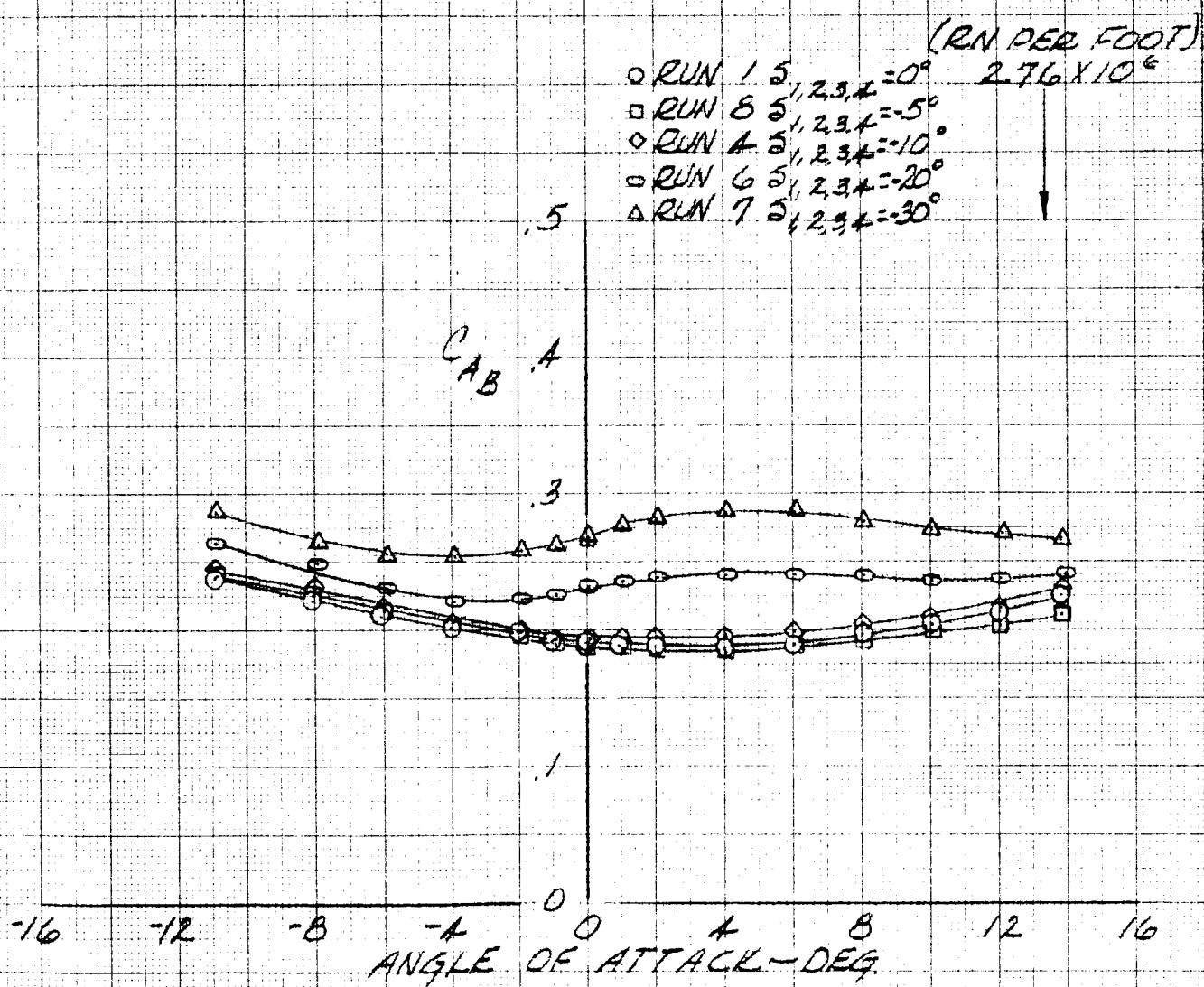


Model 12  
19 February 1963

LITTLE JOE II

Page 129  
Report No. GDC-63-025  
Figure 119

BASE DRAG CHARACTERISTICS  
LANGLEY BFT TRANSONIC PRESSURE TUNNEL  
WASHER OFF MACH NO = 0.50



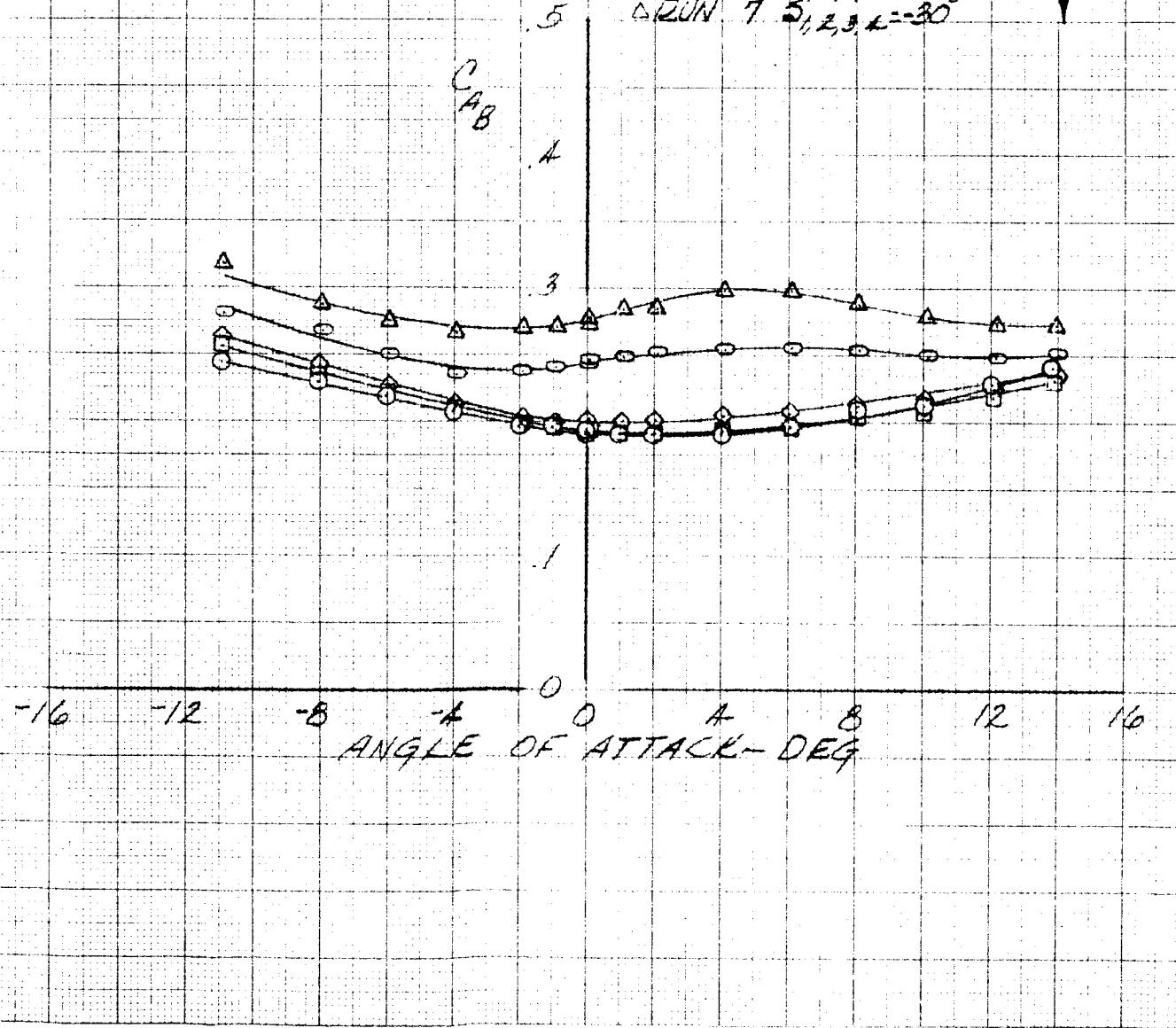
Model 12  
19 February 1963

LITTLE JOE II

Page 130  
Report No. CDC-63-025  
Figure 120

BASE DRAG CHARACTERISTICS  
LANGLEY 6 FT TRANSONIC PRESSURE TUNNEL  
WASHER OFF MACH NO = 0.70

- (RIN PER FOOT)
- RUN 1 5<sub>1,2,3,4</sub> = 0° 3.5 X 10<sup>-6</sup>
  - RUN 8 5<sub>1,2,3,4</sub> = -5°
  - ◇ RUN 4 5<sub>1,2,3,4</sub> = -10°
  - RUN 6 5<sub>1,2,3,4</sub> = -20°
  - △ RUN 7 5<sub>1,2,3,4</sub> = -30°

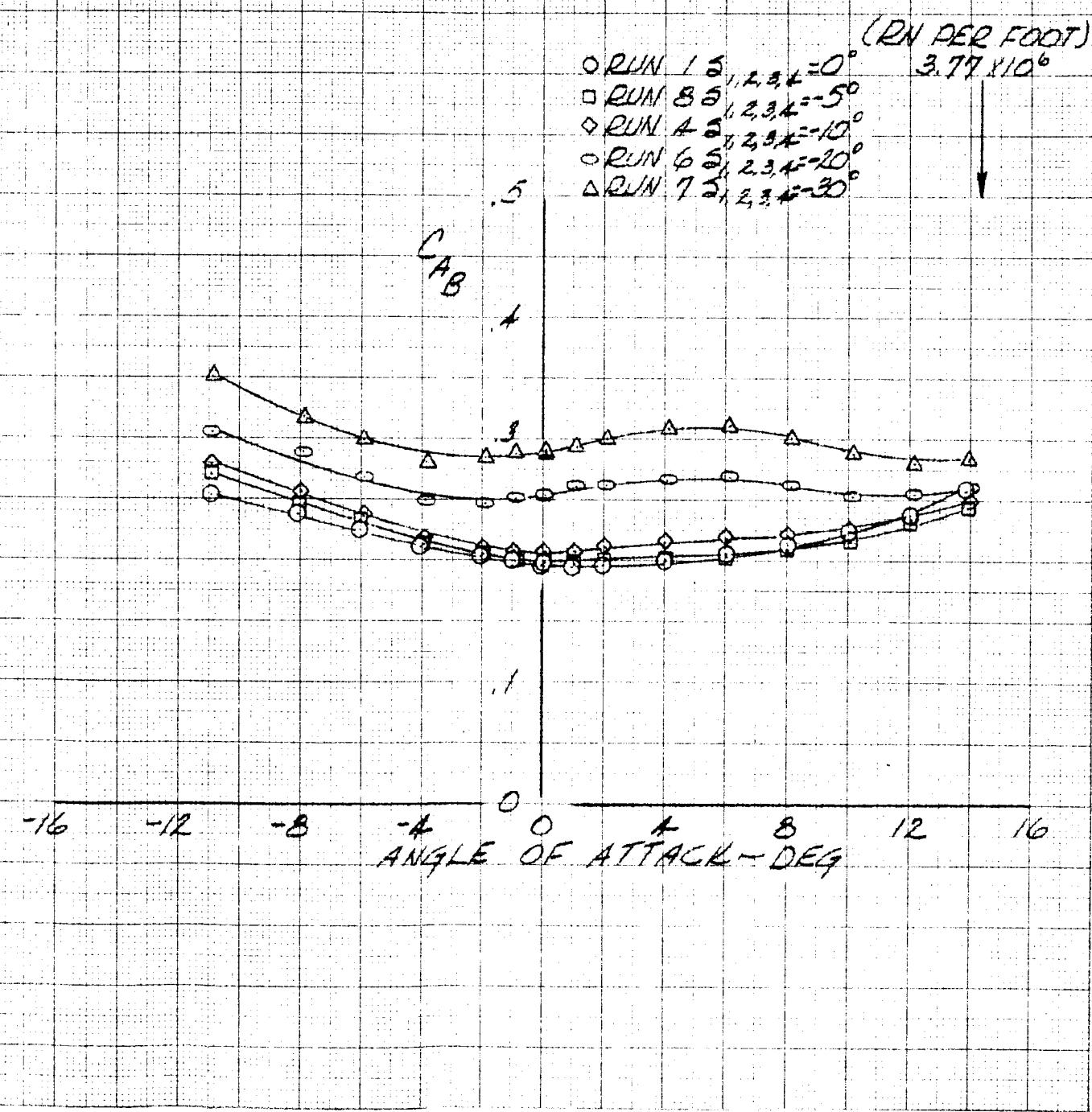


Model 12  
19 February 1963

LITTLE JOE II

Page 131  
Report No. GDC-63-025  
Figure 121

BASE DRAG CHARACTERISTICS  
LANGLEY 5FT TRANSONIC PRESSURE TUNNEL  
WASHER OFF MACH NO: 0.80

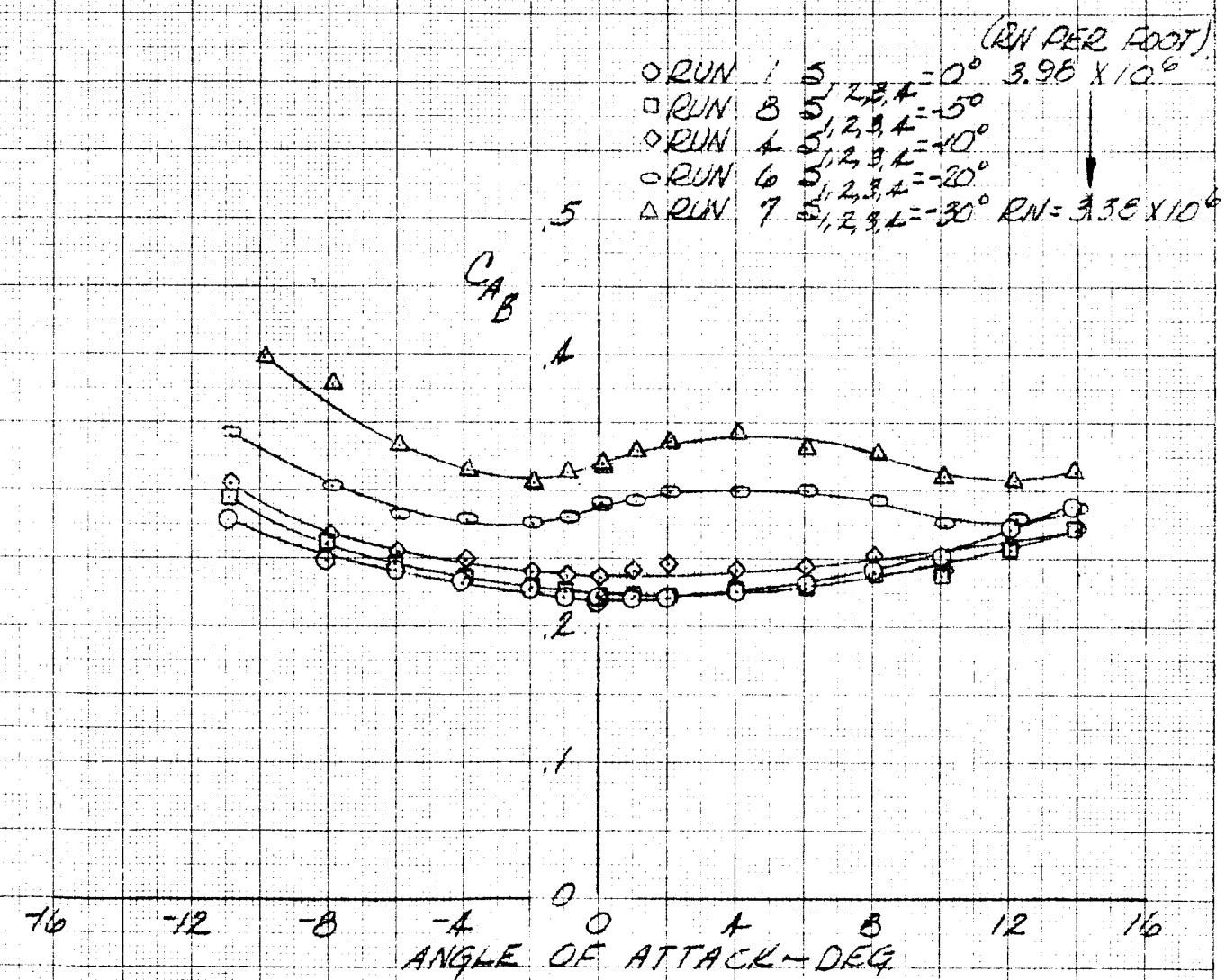


Model 12  
19 February 1963

LITTLE JOE II

Page 132  
Report No. GIX-63-025  
Figure 122

BASE DRAG CHARACTERISTICS  
LANGLEY SET TRANSONIC PRESSURE TUNNEL  
WASHER OFF MACH NO=0.90

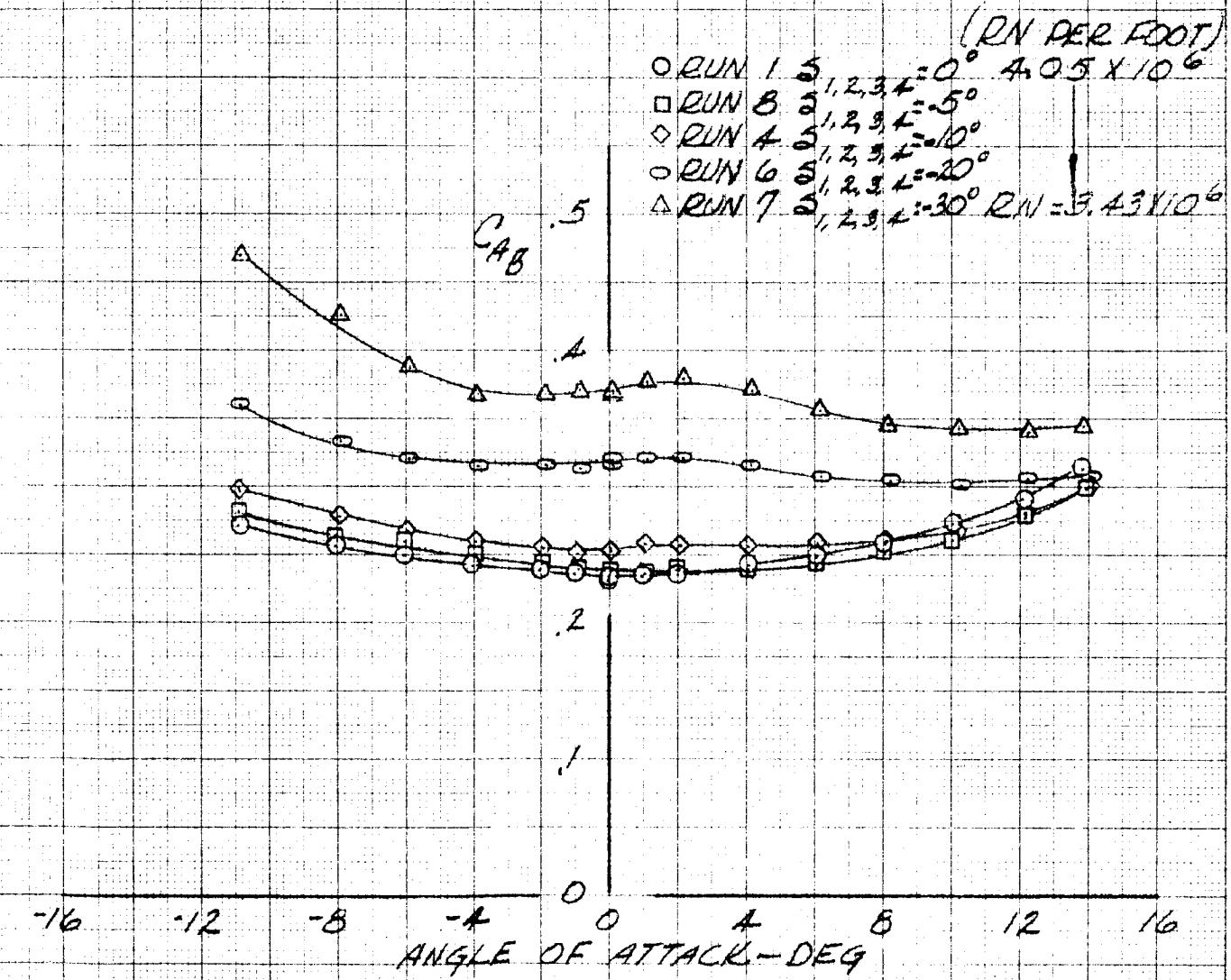


Model 12  
19 February 1963

LITTLE JOE II

Page 133  
Report No. CIC-63-025  
Figure 123

BASE DRAG CHARACTERISTICS  
LANGLEY BFT TRANSONIC PRESSURE TUNNEL  
WASHER OFF  
MACH NO=0.95



Model 12  
19 February 1963

LITTLE JOE II

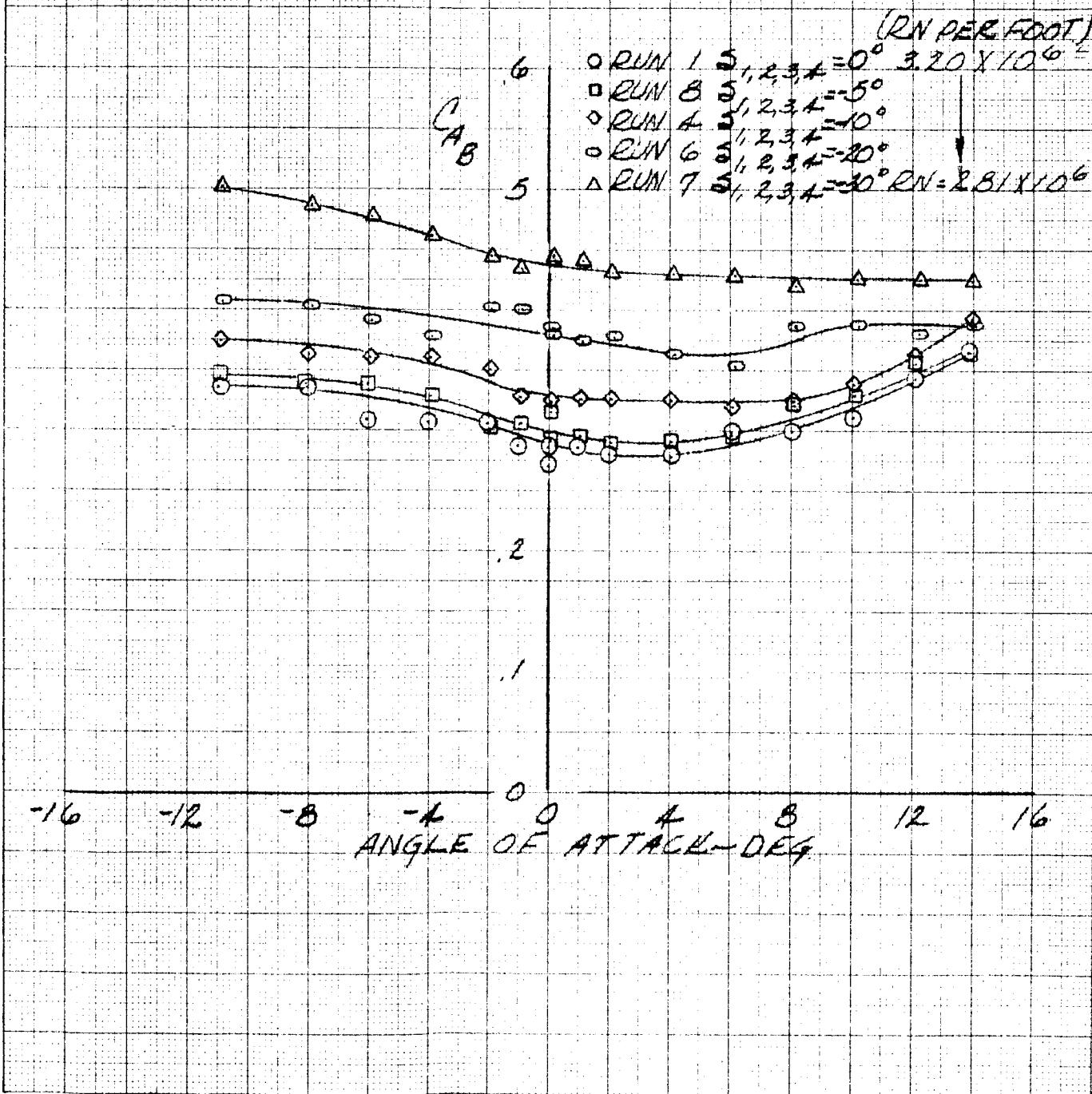
Page

134

Report No. GDC-63-025

Figure 124

BASE DRAG CHARACTERISTICS  
LANGLEY 8FT TRANSONIC PRESSURE TUNNEL  
WASHER OFF      MACH NO=1.00

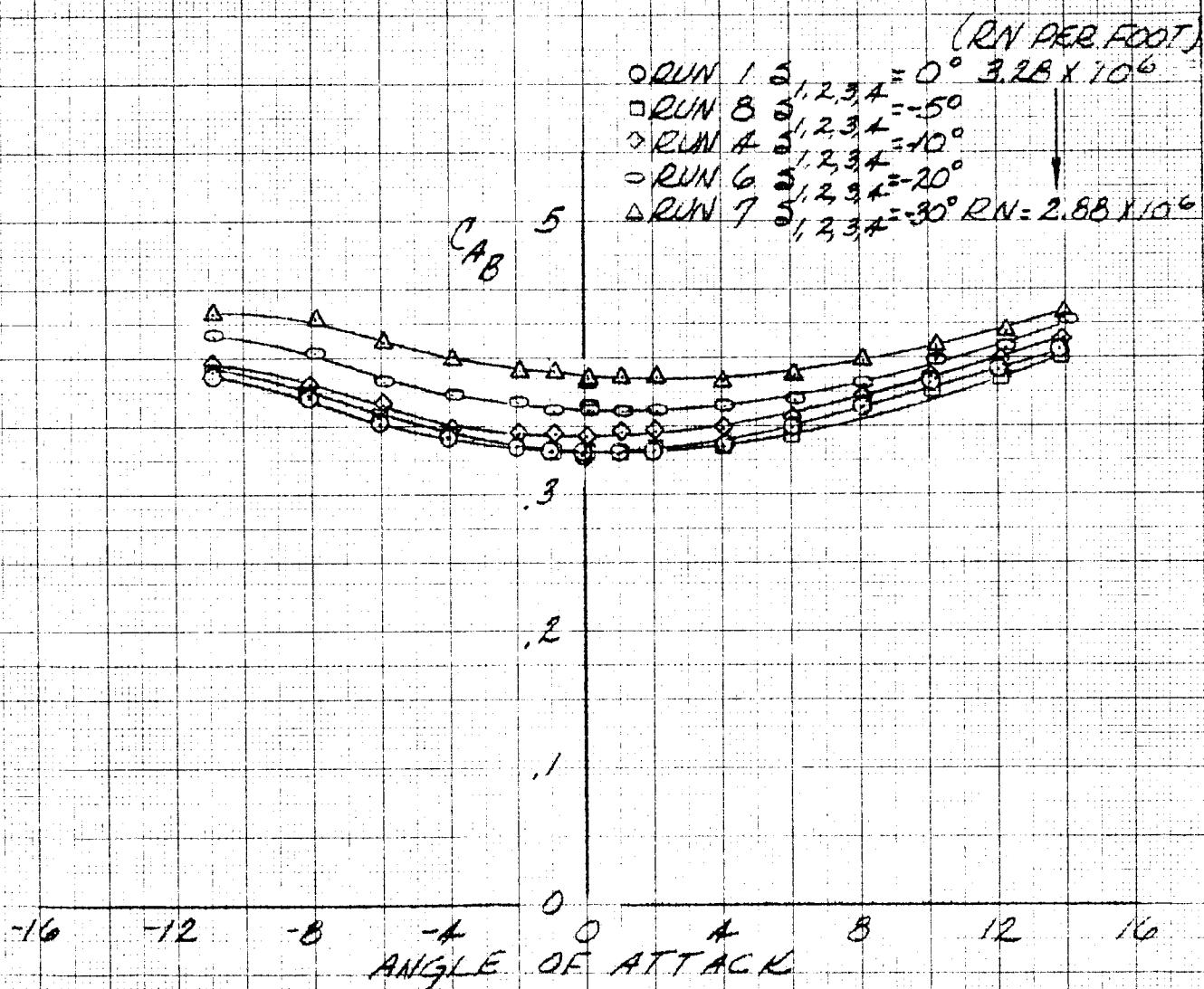


Model 12  
19 February 1963

LITTLE JOE II

Page 135  
Report No. GDC-63-025  
Figure 125

BASE DRAG CHARACTERISTICS  
LANGLEY 8FT TRANSONIC PRESSURE TUNNEL  
WASHER OFF MACH NO = 1.20

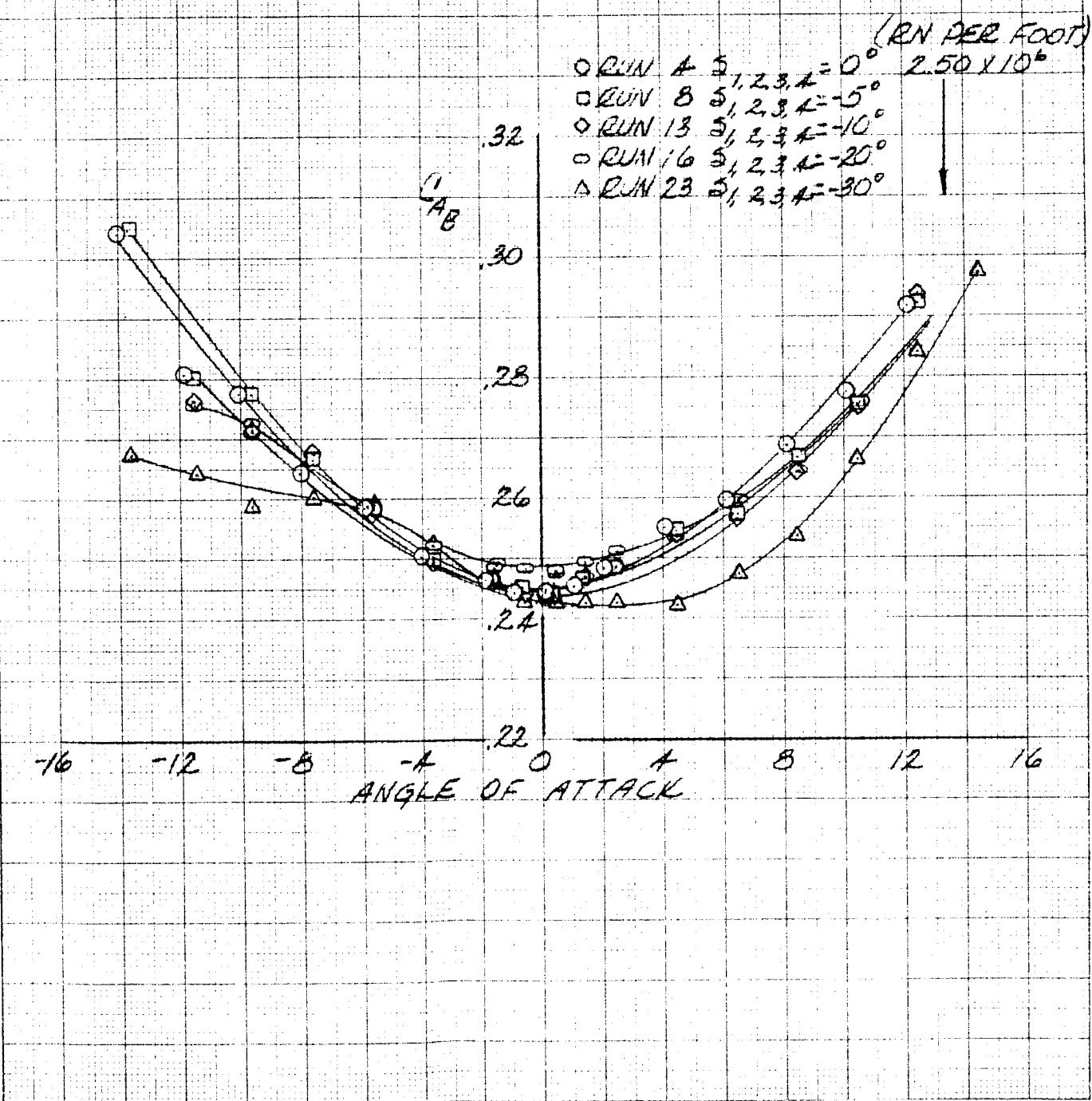


Model 12  
19 February 1963

LITTLE UGE IT

Page 136  
Report No. GDC-63-025  
Figure 126

BASE DRAG CHARACTERISTICS  
LANGLEY UNITARY PLAN SUPERSONIC TUNNEL  
WASHER OFF  
MACH NO = 1.57

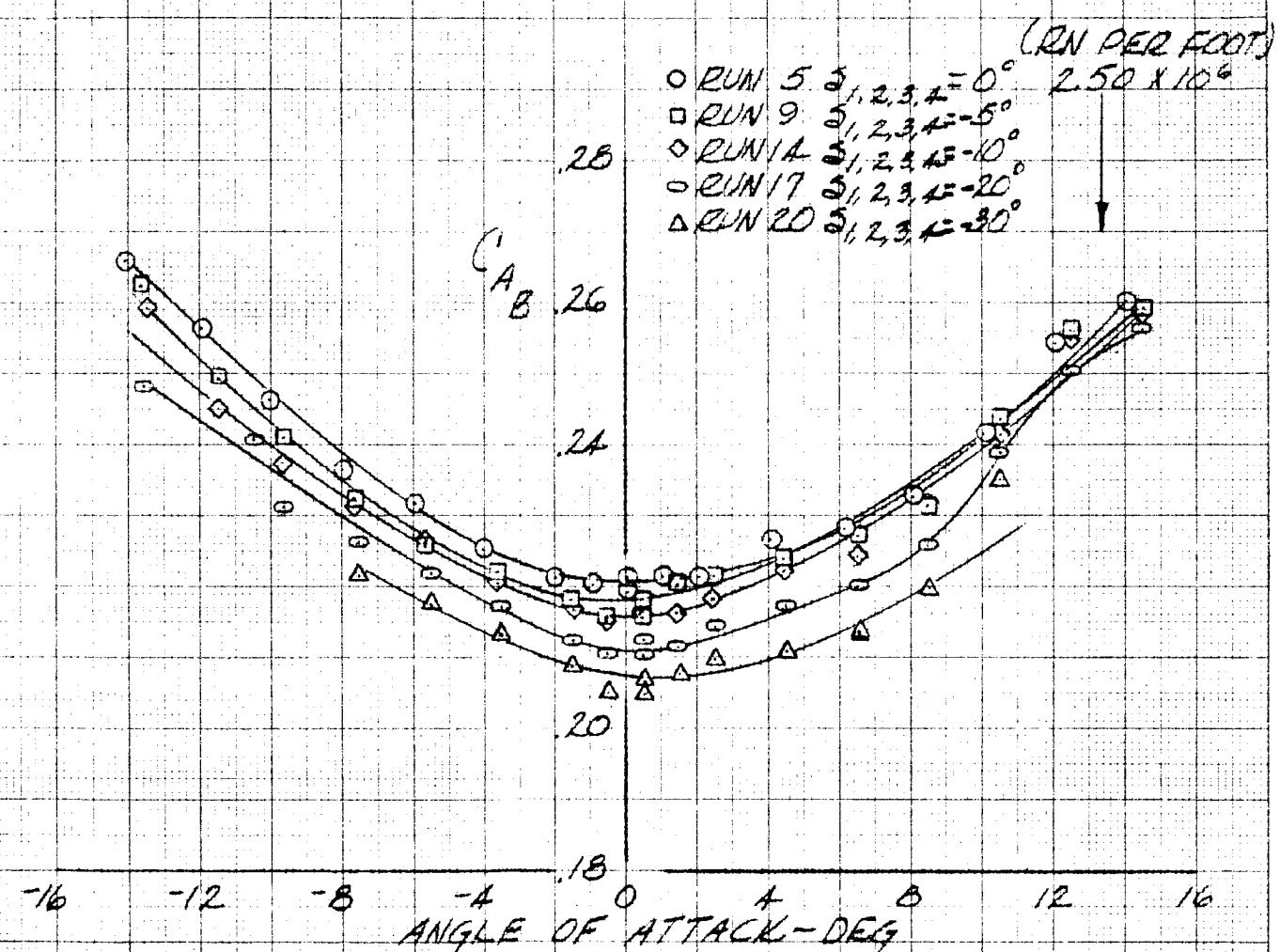


Model 12  
19 February 1963

LITTLE JOE II

Page 137  
Report No. GRC-63-025  
Figure 127

BASE DRAG CHARACTERISTICS  
LANGLEY UNITARY PLAN SUPERSONIC TUNNEL  
WASHER OFF MACH NO = 1.80

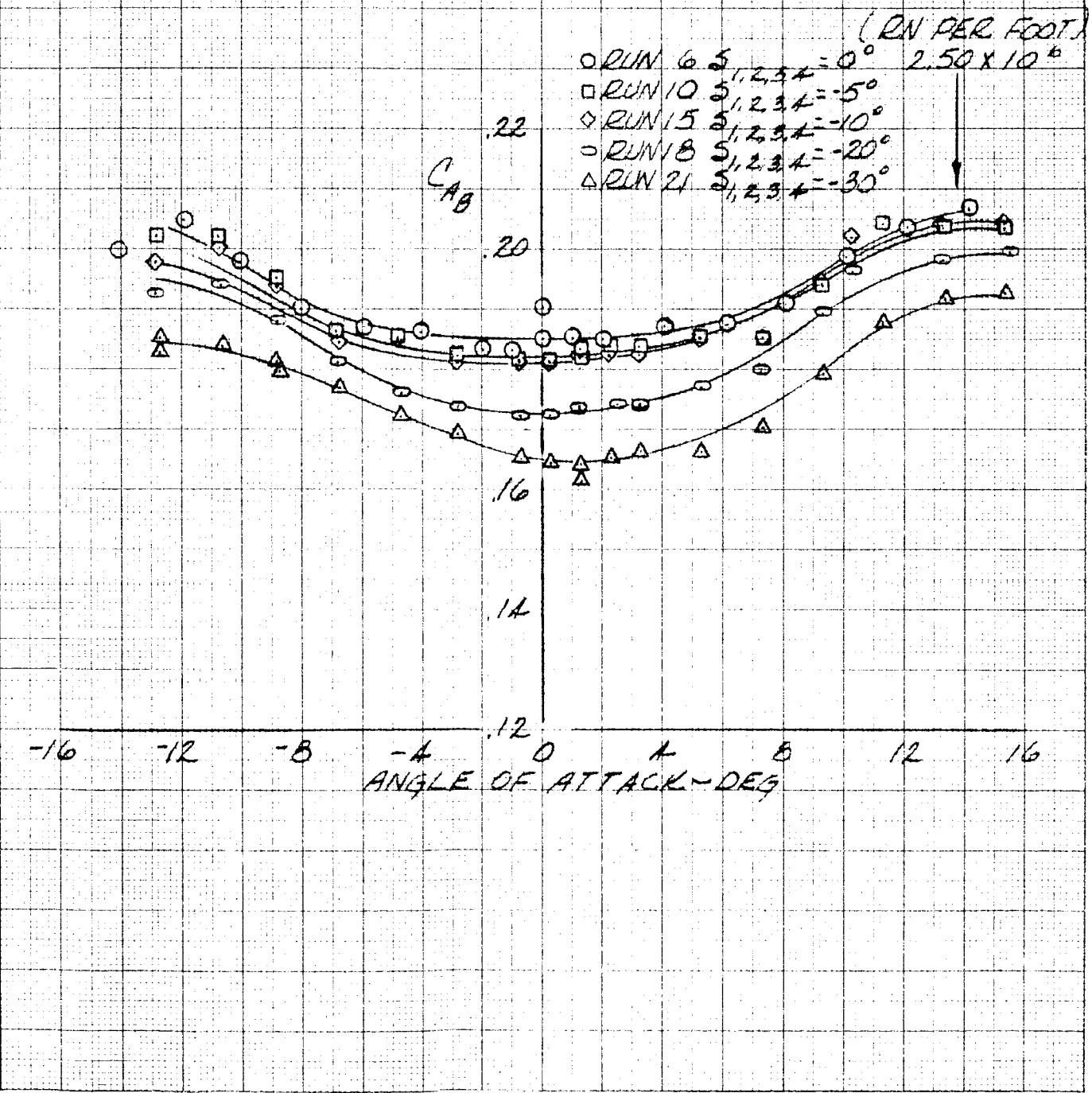


Model 12  
19 February 1963

LITTLE JOE II

Page 138  
Report No. GDC-63-025  
Figure 128

BASE DRAG CHARACTERISTICS  
LANGLEY MILITARY PLATE SUPERSONIC TUNNEL  
WASHER OFF  
MACH NO = 2.16

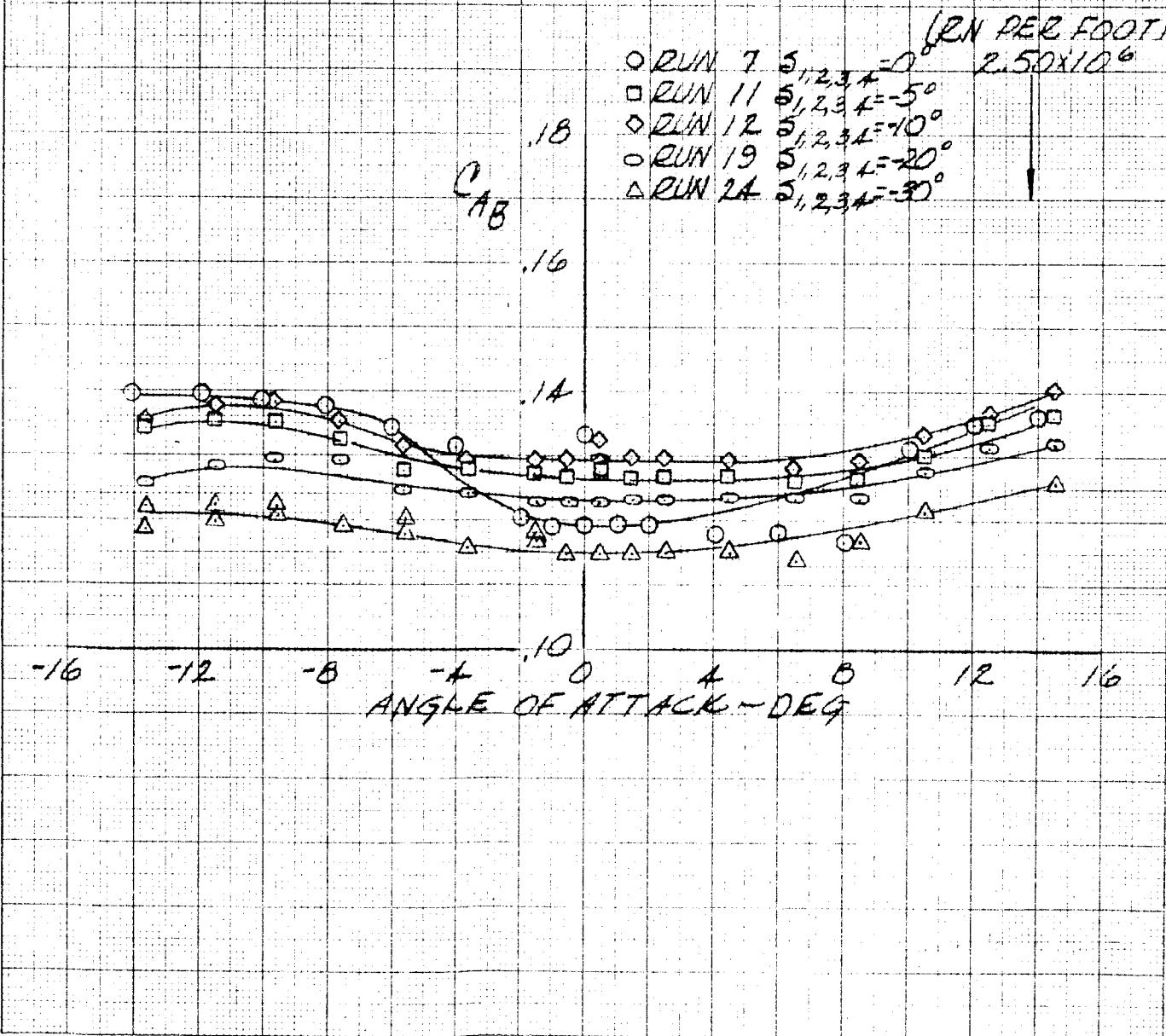


Model 12  
19 February 1963

LITTLE JOE II

Page 139  
Report No. GDC-63-025  
Figure 129

BASE DRAG CHARACTERISTICS  
ANGLEY UNITARY PLAN SUPERSONIC TUNNEL  
WASHER OFF MACH NO = 2.80



Model 12  
19 February 1963

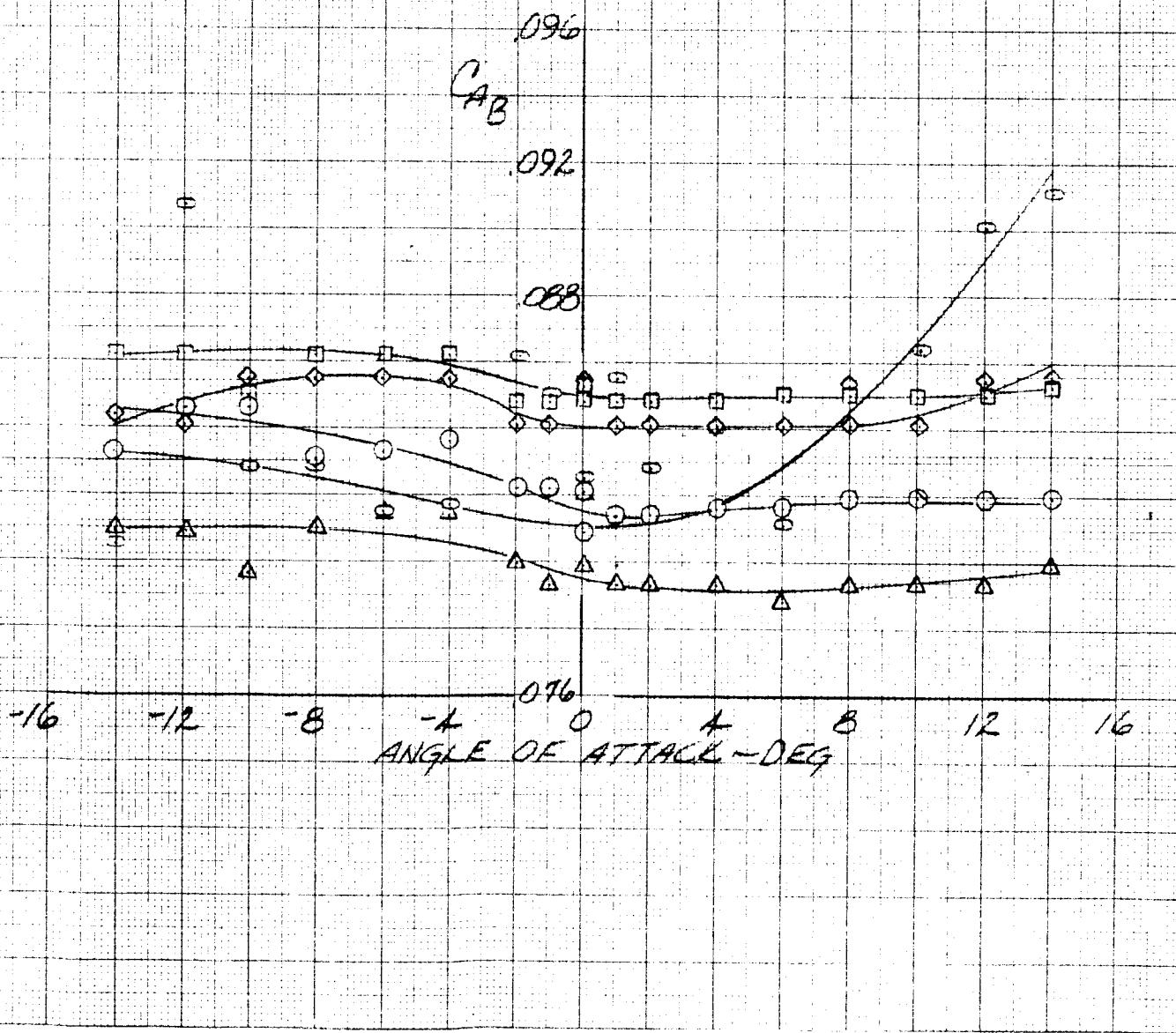
LITTLE JOE II

Page 140  
Report No. GDC-63-025  
Figure 130

BASE DRAG CHARACTERISTICS  
LANGLEY UNITARY PLAN SUPERSONIC TUNNEL  
WASHER OFF MACH NO=3.86

(RN PER FOOT)

- RUN 29  $S_{1,2,3,4}=0^\circ$   $2.50 \times 10^{-5}$
- RUN 31  $S_{1,2,3,4}=5^\circ$
- ◇ RUN 33  $S_{1,2,3,4}=10^\circ$
- RUN 35  $S_{1,2,3,4}=20^\circ$
- △ RUN 37  $S_{1,2,3,4}=30^\circ$



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Model 12  
19 February 1963

LITTLE JOE II

Page 141  
Report No. GDC-63-025  
Figure 131

BASE DRAG CHARACTERISTICS  
ANGLEY UNITARY PLAN SUPERSONIC TUNNEL  
WASHER OFF

MACH NO = 4.05

